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MARCUS DUVESKOG

Digital Storytelling for HIV and AIDS Education in Africa

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ABSTRACT

It is possible to design digital learning environments together with children even if, prior to the design project, these children are deemed ICT illiterate. Since 2002 the author has been involved in various projects in which he has been co-designing learning environments with children and youth in different parts of Southern Africa. The research from five different design settings in Tanzania and South Africa has enabled a retrospective analysis in order to identify common characteristics shared by productive design milieux. The research will show the value added by making use of digital storytelling when designing new learning environments for Sub-Saharan Africa, especially when dealing with taboo related topics such as HIV and AIDS. The thesis will highlight the factors that facilitate co-design and will show the advantages of co-designing learning environments with youth from within the context. The research has led to the development of a tool for artefact analysis, a model for evaluating the viability of learning environments and a model for analyzing design milieux that will be presented in the thesis. The thesis will emphasize the possibilities of using digital storytelling to address sensitive and delicate topics such as HIV and AIDS.

Universal Decimal Classification: 004.414.2, 004.415.2, 37.091.33

Library of Congress Subject Headings: System design; Health education; Digital storytelling; HIV infections; AIDS (Disease); User-centered system design; Educational technology; Computer-assisted instruction; Cooperation; Developing countries; Children; Africa

Yleinen suomalainen asiasanasto: systeemityö; osallistava suunnittelu; yhteissuunnittelu; tarinat; kertomukset; oppimisympäristö; tietokoneavusteinen opetus; terveyskasvatus; HIV-tartunta; AIDS; kehitysyhteistyö; lapset; nuoret; Afrikka

Preface and acknowledgements

If someone had asked me about my dreams when I was younger, my answer would never have included an academic career or doing a PhD study. What it would have included though would be a life journey which would afford me the freedom and possibilities to do the things I like and which I get excited about. After completing my high school career I honestly believed that I was done with studying. A stint working at the conveyor belts in a food manufacturing company provided me with a wakeup call and I realized that it was maybe not such a bad idea to give my future studies some serious thought as some form of qualification would open more doors of opportunity for me. I was still unsure as to *what* I wanted to study, but I began with some mathematics, followed by electronic engineering where I became interested in Computer Science and I ended up doing a master's study in Computer Science. Even though I really enjoyed programming, I could not envision myself doing the kind of jobs for which this qualification prepared me. Having been raised in Kenya, and having witnessed the living conditions of some individuals less fortunate than myself, I was always driven to work in an area where I could really make a difference and bring about a positive change in the lives of those people who hail from less privileged contexts.

At the start of my master thesis study I wanted to return to Kenya to do some meaningful research. The study counsellor at Uppsala University, where I was studying at the time, thought that it was a somewhat unconventional idea to do a master's thesis in Computer Science *in Africa*, he even questioned me as to whether they *have computers* there. He did however, although

somewhat bewilderedly, suggest that I attempt a study within the field of educational technology. There were two persons doing research in educational technology at my department in Uppsala University at that time. One of them was Anders Berglund, the first person I wish to thank, as he put me into contact with Erkki Sutinen and the University of Joensuu (now the University of Eastern Finland), and supported the idea of me doing my master's thesis in Africa.

I contacted Erkki Sutinen and he invited me to visit Joensuu (and very graciously his home as well) so that we could discuss possible themes and content for my master's thesis. I firstly needed to check the map to ascertain precisely where on earth Joensuu was and then, in the middle of winter, I took a boat across the Baltic Sea, boarded a train from Helsinki to the borderlands of Russia and, almost 24 hours later, I arrived at the doorstep of a wonderful research journey for in Joensuu my eyes were opened to the field of educational technology and the many exciting projects in the field.

Erkki Sutinen was brimming with ideas for my master's thesis and he also agreed to act as my supervisor. It was decided that I should visit Kidugala, a small rural village in Southern Tanzania, where I would do the bulk of my research. I owe Erkki a great debt of gratitude as he not only visited me in Tanzania during this time but also opened my eyes as to the endless opportunities and exciting things which could be done within the domain of educational technology. His input and guidance has been one of the main reasons why I eventually continued to pursue a PhD at UEF with him as my main supervisor and I cannot thank him enough for his active and energetic interest in my work. Over the years people have joined and people have left the research group at the department and there are many I would like to thank as they have influenced me and have helped me to grow, both personally and professionally: Roman Bednarik, Pasi Eronen, Mikko Vesisenaho, Clint Rogers, Jarkko Suhonen, Ilkka Jormanainen,

Andrés Moreno, Eeva Nygren, Carolina Islas Sedano and, especially, Matti Tedre.

The International Network for Postgraduate Students in the area of ICT4D (IPID) afforded me valuable support and insights. There were other individuals in my department at Joensuu who were interested in ICT4D but, like many other researchers, I sometimes felt isolated in my focus on ICT for development. Through IPID I was introduced to a large number of students from different countries and backgrounds who shared my curiosity and passion as to how modern technologies can be employed to benefit people in developing regions of the world. In this regard I especially like to thank Tim Unwin, Ismael Peña-López, Gudrun Wikander and Annika Andersson.

This journey however started much earlier when, at the age of eleven months, my parents first brought me to Africa. My early childhood years, which were spent in Kenya, had a big impact and influence on my choices later in life. I would like to thank my parents for not only always being there and for supporting me but also for opening my eyes, early on in my life, to what a lovely continent Africa really is. The ways we set about it may have been different, but my parents are the ones who taught me the importance of doing something meaningful for or together with people who are less privileged than you and, through living that principle, they showed me how rewarding it can be to make a positive difference in the lives of others.

During my PhD journey I have travelled and worked on different projects in different African countries and this has required extensive funding. I would like to thank those individuals and institutions who have helped me in securing funding for my studies: the School of Computing department at the University of Eastern Finland through various project involvements, the Meraka Institute, the Academy of Finland and the Ministry for Foreign Affairs in Finland. I would also like to thank the Finnish Evangelical Lutheran Mission (FELM), and

especially Kati Kemppainen, who secured funding for my Tanzanian tenure during which I helped develop a digital platform for HIV and AIDS education - an experience which later evolved to form the core of this PhD study. During my work on the HIV and AIDS platform I was also afforded the opportunity to collaborate closely with my Tanzanian friend, Christian Mwamanga. I would like to thank him warmly for his great help with this project and for being my close friend since we first met in 2002.

As I am a bit of a nomad and tend to move around between the northern and southern hemisphere, it has been very convenient that my co-supervisor, Johannes Cronje, resides in South Africa. Even though I have not always used his proximity to my academic advantage, I would like to thank him for his guidance, for challenging me and for making me feel welcome in his research group at the Cape Peninsula University of Technology (CPUT). I am also grateful for the contributions by the language fairy Estee Wiese that helped in making the thesis more readable.

The persons that have arguably contributed the most towards this PhD are all the students and young people that I have had the privilege to work with on different projects. Without their collaboration and enthusiastic active participation, there surely would not have been much to report upon in this thesis! It has been wonderful to work with students in Africa who, according to my experiences, have a hunger to learn more about new technologies (from this foreigner) and who really want to be included in the new globalised world of which they might have heard but to which they have only been marginally exposed.

Last, but not least, I would like to thank my travel companion/girlfriend/fiancée/wife Heidi Assumption/Duveskog for her amazing support. She has given me space (when I needed it), help (when I needed it) and she has patiently

supported me even during longer periods of absences. Most of all, she has believed in me when I doubted myself.

Cape Town, December 16, 2014

Marcus Duveskog

LIST OF ABBREVIATIONS

AIDS	Acquired immune deficiency syndrome
ARV	Anti-retroviral drugs
CATI	A model for technology transfer (Contextualize, Apply, Transfer, Import)
CPUT	Cape Peninsula University of Technology
CSIR	Council for Scientific and Industrial Research
EEPD	Empowering Education Processing Diaconia
FELM	Finnish Evangelical Lutheran Mission
FODEM	Method for developing digital learning environments (FOrmative DEvelopment Method)
GDP	Gross Domestic Product
HIV	Human immunodeficiency virus
ICT	Information and communication technology
ICT4D	Information and communication technology for development
IEEE	Institute of Electrical and Electronics Engineers
IMPDET-LE	International Multidisciplinary PhD Studies in Educational Technology and Learning Environments
IPID	The International Network for Post-graduate Students in the area of ICT4D
IT	Information Technology
LWF	Lutheran World Federation
m-CADE	Multilayered Framework for Compiling Digital artefacts by Extension
NGO	Non-governmental organisation
OLPC	One Laptop per Child association
STIFIMO	Programme for Cooperation in Science, Technology and Innovation between Finland and Mozambique
TEDC	International Workshop on Technology for Education in Developing Countries
UEF	University of Eastern Finland
UKIMWI	Swahili abbreviation for AIDS
YESA	Young Engineers of South Africa

LIST OF ORIGINAL PUBLICATIONS

This thesis is based on data presented in the following articles, referred to by the Roman numerals I–VI.

I Duveskog, M., Vesisenaho, M., Randolph, J., & Sutinen, E. (2010). Beyond taboos: Expressing HIV/AIDS attitudes through contextualized learning technology. In World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education (Vol. 2010, No. 1, pp. 68–73).

II Bada, J., Duveskog, M., Suhonen, J., & Sutinen, E. (2009). Towards viable technology for HIV/AIDS education. In P. Cunningham, & M. Cunningham (Eds.), IST-Africa 2009 Conference Proceedings. IIMC International Information Management Corporation. ISBN: 978-1-905824-11-3.

III Duveskog, M., Kemppainen, K., Bednarik, R., & Sutinen, E. (2009). Designing a story-based platform for HIV and AIDS counseling with Tanzanian children. In Proceedings of the 8th International Conference on Interaction Design and Children (pp. 27–35). ACM.

IV Duveskog, M., Tedre, M., Sedano, C. I., & Sutinen, E. (2012). Life planning by digital storytelling in a primary school in rural Tanzania. Educational Technology & Society, 15(4), 225–237.

V Duveskog, M., & Sutinen, E. (2013). Enriching student HIV awareness by digital storytelling. In Journal of Educational Multimedia and Hypermedia, 22(4), 229–252.

VI Duveskog, M., Sutinen, E., & Cronje, J. (2014). Design milieux for learning environments in African contexts. In British Journal of Educational Technology, 45(4), 581–594.

The above publications have been included at the end of this thesis with their copyright holders' permission.

AUTHOR'S CONTRIBUTION

All of the papers were written with or under the supervision of the main supervisor, Prof. Erkki Sutinen. With paper (IV) the second supervisor, Prof. Johannes Cronje, also assisted in the researcher through his contributions and supervision.

I The author of this dissertation is the main writer of this paper that is based on the outcomes of a programming course that the author presented to students in rural Tanzania. The data analysed in this paper was collected and/or recorded by the author during the actual teaching sessions in Tanzania. The development of the tool for artefact analysis was a joint effort between all the writers.

II The author is the second writer of the paper which elaborates on the viability and transferability of the *Sura ya UKIMWI* platform for other contexts. The paper and the analysis was a joint effort between all the authors. As the paper dealt with the possibility of transferring *Sura ya UKIMWI*, the platform which the author had developed in conjunction with young people in Tanzania, into other contexts, his contributions were major. In this paper we specifically investigated the possibility of re-using the platform in the Ugandan context and the first author, Joseph Bada, contributed the context analysis for Uganda.

III The author is the first writer of and the main contributor to this paper. The paper explains how *Sura ya UKIMWI* was developed in accordance with participatory design principles. The paper is based on records and observations made by the author but the co-writers assisted in presenting the work and contributing to the background and presentation of the paper.

IV The author is the first writer of and the main contributor to this paper. The paper is based on a digital storytelling workshop presented by the first and the third author, Carolina

Islas Sedano, at a primary school in Tanzania. The analysis of the workshop and the data was mostly done by the main author. In this analysis traditional storytelling is compared to digital storytelling. The main author was also the main contributor but received significant help from the co-writers.

V This paper was written in conjunction with the main supervisor, Prof. Erkki Sutinen. The author is the first writer and main contributor. The paper is based on the work carried out by the author during his development of *Sura ya UKIMWI* in Tanzania. The paper is based on the paper 'Enriching student HIV stories by the use of Technology' that was awarded an 'Outstanding paper award' at the ED-MEDIA 2009 World Conference on Educational Multimedia, Hypermedia & Telecommunications in Honolulu, Hawaii (Duveskog, 2009).

VI The author is the first writer of and the main contributor to this paper which was written in conjunction with both the main and second supervisor. The paper is based on the research done at five different design milieux where the author was either the driving force or in which he was extensively involved.

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1 Introduction

While I have been advised to *start* my research where the literature *ends*, I have rather chosen to undertake a more anthropological minded journey. This approach has prompted me to live close to youth, people and communities in order to *work with them* and *learn from them* and consequently to build my theories and assumptions based on real life experiences and intuition rather than using literature as the starting point of this research work. One of the main reasons for choosing this approach is that I detected a gap between academic reports and the real life situations and experiences which I personally observed. Computer Science academic reports tend to focus on technical aspects and do not place enough emphasis on the *context itself* or the *individuals within the context*. In contrast, I find it more interesting and rewarding to use the context and the people within the context as a starting point from which to launch my enquiry into how technology can or should be applied to benefit the people within that context.

The research presented in this thesis is a combination of different attempts and approaches to find and forge novel ways of using technology to help solve problems and challenges faced by ordinary people. The focus has been on *technology in education for the youth* in which young learners have been encouraged to find uses for technology (including programming, computers and mobile phones) to directly benefit their personal situation and/or the situation of their community.

My research journey has been a rather long and epic passage, dynamic in its very nature. My original ideas and thoughts have evolved and changed along the way as I became involved in new projects which opened up interesting and brand new research possibilities. The main body of research, which is

presented in this thesis, was conducted in Tanzania. However, I also draw conclusions based on my research experiences in South Africa, Mozambique, Kenya and Zambia.

This journey of discovery started in 2002 when I travelled to Tanzania to do research for my master's thesis which was based on the introduction of programming to students at a rural secondary school in the Southern highlands of Tanzania (Duveskog, 2004). During a period of almost three months I lived close to the students which afforded me valuable insights into their everyday life, thoughts, dreams and culture. I made many new friends, a few of which have remained my close friends till today. Paper (I) and (VI) of the thesis draw on the experiences gained in this period.

In the years 2003 to 2006 I did part-time work as a research assistant, primarily involved with the design and development of a contextualised programming course for Tumaini University. During this process I did a significant part of the course design, teaching and the implementation of the programming course at Tumaini University which was later reported upon by Mikko Vesisenaho in his PhD thesis (Vesisenaho, 2007). Conclusions from this research study are partly dealt with in paper (VI).

During 2005 and 2006 I was involved in ICT training for teachers and the consequent integration of ICT in teaching at The College of Business Education in Dodoma and Dar es Salaam, Tanzania. In 2006 I acted as conference secretary for the 4th Institute of Electrical and Electronics Engineers (IEEE) International Workshop on Technology for Education in Developing Countries (TEDC) which was a joint effort between Tumaini University and the Department of Computer Science[1] of the then University of Joensuu[2]. Although this thesis does not communicate the details of these experiences, they nevertheless

[1] The current name of the department is *School of Computing.*

[2] University of Joensuu merged with University of Kuopio in 2010 to form the University of Eastern Finland.

provided me with important knowledge and understanding regarding the challenges faced by higher educational institutions in developing countries. Lessons learnt were, amongst others, the impact of a lack of previous exposure to computers in the case of both students and staff. In many cases we had to start with the very basics, for instance explaining how to use a mouse and keyboard. The undeniable gap between the *actual ICT literacy skills* taught at the college compared to the ICT knowledge which *students were expected to have* in order to secure employment after completing their studies became clear to me. I was also exposed to the fears which teachers and staff harbour regarding technology, fears which need to be addressed when one is trying to integrate ICT into teaching and administrative practices. Another interesting eye-opener was the importance afforded to *status* and *status symbols*, in so far that it sometimes seemed as if the status connected to *having technology in the office* seemed to far outweigh *being able to use* the technology.

All the activities up to this point, apart from my master's thesis, were executed through the University of Eastern Finland (UEF) with the express intention of gathering enough research material to launch my own PhD studies. At the end of 2006 I finally obtained my master's degree and subsequently enrolled as a PhD student in the International Multidisciplinary PhD Studies in Educational Technology at the University of Joensuu.

At this time I was offered a research grant to work for the Meraka Institute at the Council for Scientific and Industrial Research (CSIR) in Pretoria for one year to help them start up technology clubs, named TekkiKids, in South Africa. Originally this experience was meant to form the core research body of this PhD. When I joined the project it had, however, already been launched and the parties involved had quite definite ideas on how it should be run. I felt that the TekkiKids project did not provide me with the kind of environment where I could freely test my own ideas, an important pre-requisite for any PhD, in that I had to facilitate that which had already been planned by others. In retrospective, I would have preferred the experiences,

backgrounds and ideas of the learners to take central stage in the facilitation of the TekkiKids activities. Despite it having been a great learning experience for both myself and the youth involved, it could be deemed as more *analysing* in character as opposed to the *shaping of own ideas* and frameworks. A part of this research experience is however dealt with in paper (VI).

In 2008 I started to work on the Empowering Education Processing Diaconia (EEPD) project. EEPD was a HIV and AIDS counselling project that, amongst other things, was involved in: starting a counselling programme for students at Tumaini University in Iringa, creating support groups at hospitals and offering micro credits (interest free small loans) to infected women. My task in the project was to develop a digital platform for HIV and AIDS counselling for the youth in Tanzania. I was given free reigns as to the development of this platform and this experience afforded me the opportunity to test my *own ideas* and *development approaches* which, in turn, came to form the core of this PhD. The platform, which was developed in conjunction with Tanzanian youth, was named in Swahili *Sura ya UKIMWI* which translates as *The Face of AIDS*. The research carried out in this project is dealt with in papers (III) and (V) and also partly in papers (II) and (VI).

In late 2009 a two week workshop was organised at Ukombozi primary school in Iringa, Tanzania. This workshop, named *Working for my dreams*, took the form of a digital storytelling experiment and was carried out in a one-to-one computing setting among primary school children. During the workshop we used XO-1 laptops which had been provided to the school by the One Laptop per Child (OLPC) Association. In the course of the workshop students designed digitally woven stories and hypercontextualized games (Sedano, 2012), related to their dreams and aspirations, in which they had to reflect upon life choices and issues related to HIV and AIDS. The research presented in paper (IV) was carried out as a result of this workshop.

During the period 2011 to 2012 I aided in the founding of technology clubs and conducted Kids' Club training in Maputu, Tete and Nampula in Mozambique through the Programme of Cooperation in Science, Technology and Innovation between Finland and Mozambique (STIFIMO). STIFIMO focuses on capacity building on different levels and in various areas of science, technology and innovation. The first Kids' Club was started at the University of Joensuu in 2001. The concept of the Kids' Club is to create an environment in which researchers in educational technology can actively support young people using various kinds of technology in creative an innovative ways. The Kids' Club training in Mozambique included workshops on robotics, programming and digital storytelling. The training was conducted for students and teachers at primary and secondary schools, technical colleges and universities. This was an enriching and educational experience which, although it is not directly covered in the thesis, was useful and helpful as it facilitated a better understanding of the different conditions in which people are living, studying and working within developing contexts and has afforded me a better insight into the opportunities and challenges facing ICT integration in the context of developing countries in Southern Africa. The work with the Kids' Clubs in Mozambique gifted me with the opportunity to work with teachers and students from a wide range of educational backgrounds and this in turn afforded me a balanced insight into ICT integration, or the lack thereof, in the Mozambican educational system. One of the primary schools in which we were working lacked basic resources such as chairs and desks and the children were taught in big groups whilst sitting on the floor. This raised certain *ethical issues* concerning the introduction of high end technology into settings that lack the very basic amenities. Working closely with the Ministry of Science and Technology also provided a good grasp of the possibilities and challenges faced when aiming to *convert good ideas into real life practice* in schools at ministerial level.

In the beginning of 2012 I was invited by The Lutheran World Federation (LWF) to work with a youth group at LWF in

Maputo. The aim of the workshop was to test the possibility of re-contextualising the *Sura ya UKIMWI* platform for use in Mozambique. During the eight day workshop the participants created one digital story in Portuguese. Later on an Android version of the story was also generated. The experiences lived during and the lessons learnt from the workshop are briefly mentioned in paper (V) and also relate to paper (II) which deals with the possibility of re-contextualizing *Sura ya UKIMWI* for other contexts.

During 2012 I worked on a collaborative project between the University of Eastern Finland (UEF) and the University of Eldoret which dealt with ICT integration in forestry education at the University of Eldoret. One of the tasks was to design an educational forestry game for Android devices in conjunction with the students. The development of this game, called *EntVenture* (Duveskog et al., 2013), does not form part of this thesis but was nevertheless a useful learning experience in my PhD journey. At the end of 2013 I once again became involved in a developmental project to create a new Android game together with students from the University of Eldoret. This game, *Eucalyps*, which is narrative based, is still being developed. Its aim is to educate the youth about the importance of forests and the need to conserve them.

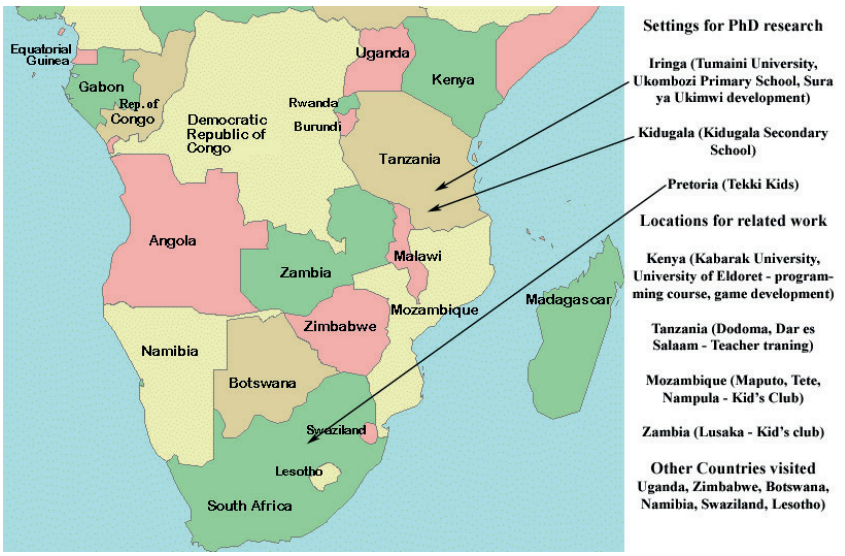

Figure 1. *Map of Southern Africa and the author's travels there in*

The research, as reported on in the thesis, mainly took place in South Africa and Tanzania with the majority of the research originating from Tanzania. I have however, during my research tenure, also gained valuable experiences from many other Southern African countries as illustrated in Figure 1. Whenever one talks of *Africa* in general terms, one will do well to remember that it is a vastly large continent as illustrated in Figure 2. It is also a *very diverse* continent which is home to more than a thousand different ethnic groups who (mostly) have their own languages as well. Africa is made up of almost 60 countries and there are significant cultural and geographical differences across the continent. With this said, there are also *several similarities* between many of the countries. All countries in Southern Africa for instance have a high HIV and AIDS prevalence rate with a crucial part of the population living under the poverty threshold (refer to Figure 3). Most of these countries are rich in natural resources and have a GDP growth rate of about 5.5% which is high when compared to the rest of the world (IMF, 2013). Based on my own experiences of living, working and travelling in Southern Africa, I sometimes refer to Africa in general terms, as in the title of the thesis. Any general conclusions made in the thesis are, to a large extent, based on

experiences gained of the countries and contexts in which I have visited and worked.

Figure 2. *Illustration depicting the size of Africa in relation to other parts of the world. Source: flowingdata.com/2010/10/18/true-size-of-africa/*

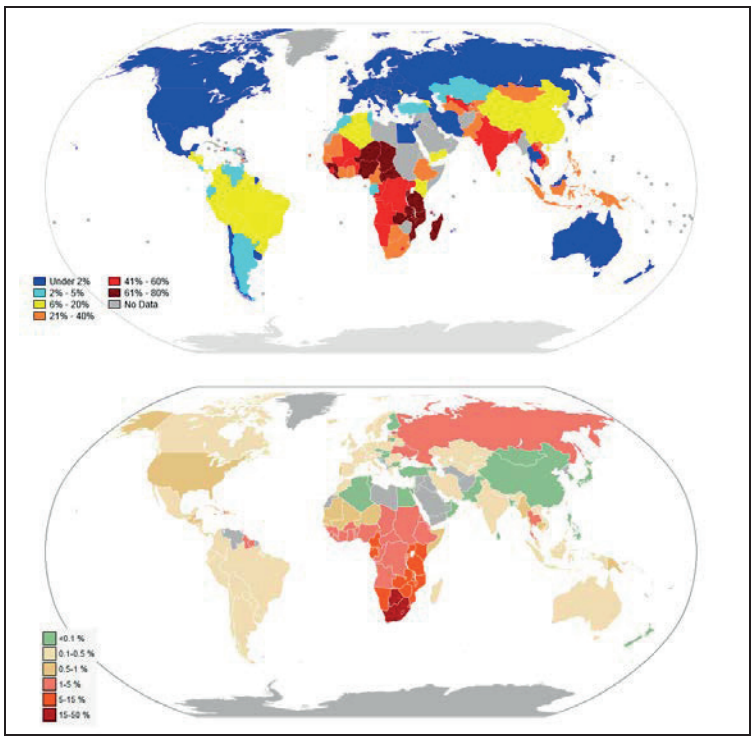

Figure 3. *The top picture shows the percentage of people living under the poverty threshold and the bottom picture shows the prevalence of HIV (source: UNDP and UNAIDS)*

Africa, as I have come to know it during the past twelve years, is a rapidly changing continent which is perfectly suited to *development related research* and then especially research regarding the role of technology *for* development. When I started with research towards my master's thesis in 2002, the level of ICT literacy was very low in Tanzania. Not many people had access to computers and mobile coverage was still very limited. Internet users were estimated at 0,2% in 2002 but this number grew to 13,1 % in 2013. Mobile phone subscribers increased from 2% to 57% during the same period (Worldbank, 2014). Previously, anti-retroviral drugs (ARVs) were only deemed for use by the rich and privileged and becoming infected with HIV was seen as a hopeless death sentence but that has changed. Today there is real hope for someone who has contracted HIV as ARVs are becoming readily available, even to poorer individuals living in rural settings.

The media often portrays Africa as a very dark continent, plagued with catastrophes, starvation and a myriad of other problems. I have also experienced hunger on the African continent, but hunger of a different kind – the *hunger* to learn, the *hunger* to be a part of the global community and the *hunger* for success. Working closely with its young people, makes one see this continent in a rosier light. One realises that there is indeed a strong *feeling of optimism* towards a better future. There is an abundance of talent and enthusiasm amongst the youth wherever one goes and this makes the African milieu conducive to the design and application of innovative and novel ideas.

Traditional teaching methods, especially those inherited from the colonialists, have not been resoundingly effective in stimulating the strengths of the young. New approaches, new technologies and new teaching methods can gift the young generation with a better chance to reach their potential. Through this research we will show exciting new ways of employing technology which will empower the youth as *creative doers* and not only *passive consumers*. Various attempts at combining the best elements of traditional learning with new ways of expression have led us to work seriously with the element of digital storytelling. HIV and AIDS have long been regarded as one of the most important threats to development and, as we discovered, everyone is affected by the disease in one way or another. We consequently started looking at ways in which to accommodate the use technology in HIV and AIDS education.

Most of the research which is reported upon in the thesis is ground breaking. Much research has been done on digital storytelling, computer aided HIV and AIDS education, participatory design, technology clubs for the youth and design milieux but very little research on these topics has however been done *within the African context* and especially in settings where users have had limited previous exposure to computers and

modern technologies. This element is primarily that which infuses this study with a particular uniqueness.

Unlike most related research, this is a Computer Science thesis which also requires an element of *construction*. The construction of the digital learning environments done during my PhD journey, together with the published papers included in the thesis, constitute my main contributions to the field.

1.1 RESEARCH QUESTIONS TO BE ADDRESSED IN THIS THESIS

The research questions which this thesis aims to address *thematically bind the individual papers together* as they have been derived from the content of, and the research questions which underpin each of the papers included in the thesis.

Q1: Which values are added by making use of digital storytelling in the design of new learning environments for Sub-Saharan Africa?
Q2: When designing learning environments for the youth in developing contexts, what are the advantages of co-designing these environments together with the young people who live within them?
Q3: What are the factors that facilitate the process of co-design?
Q4: What are the characteristics of a productive design milieu?

1.2 KEY CONCEPTS

Participatory design: This is a design approach where all the stakeholders are actively involved in the design process in order to design a product that is usable in accordance with the needs of the stakeholders. *Participatory design* relates to the principles

of *action research* where the researcher is not merely an observer but works together with a community or group to improve the problem solving capabilities through a cyclical process of planning, acting, observing and reflecting. The main reason for participatory design is to meet the users' cultural, emotional, spiritual and practical needs in the design. Participatory design also helps to bring the *end-users into the world of researchers and developers*. The way in which we have applied participatory design in this research is to co-design with the end-users in an attempt to include them as much as possible in the whole design process. Since the students' context and backgrounds differ vastly from that of the researcher, participatory design has been a medium through which a better understanding of their needs, context and interests has been gained. Involving the end-users in the design process *has enabled a transfer of ICT skills* to the youth involved. At the same time it has given them a chance to add to the creative process by contributing their knowledge, skills and ideas.

Digital storytelling: Digital storytelling uses digital media to express, store and share stories. The difference between *digital storytelling* and *traditional storytelling* is that the first mentioned, through the use of evolving new technologies, opens up new possibilities to presenting and sharing stories (through the Internet for instance). Digital storytelling allows for more interactivity and facilitates options for non-linear storytelling. Digital stories are generally presented through the combined use of photographs, video, animation, sound, music, text and a narrative voice.

Design Milieu: This refers to the *natural essence* of the context in which the design process is taking place. The word *milieu* is synonymous with surroundings, setting, scene, environment, element, background, location and sphere and its etymology refers to *middle-ness*. The design milieu includes the *social and cultural aspects* of those people involved in the process as well as their *surrounding reality* which includes their physical location,

available infrastructure, educational background, ambitions and goals as imposed by the context.

Learning Environment: In this thesis learning environment refers to the *learning tools* designed as a part of this research. The learning environment is the technical platform, together with the content generated for the platform, which allows people to use it and learn through it. The learning environments, as referred to in the thesis, were at first designed to be digital in nature but due to lack of access to computers in some contexts, non-digital learning materials have also been created as in the case of *Sura ya UKIMWI*. The non-digital learning material also forms part of the learning environment.

Ownership: In the context of this thesis *ownership* does not refer to a person physically possessing something but rather to *the feeling of ownership*. It refers to the sense of having been included and having been able to contribute which, in turn, leads to a sense of pride as regards the technology or designed intervention. While access refers to the availability of technology (in line with the universal meaning of access), ownership requires that users are able to express themselves through the available technology. The World Wide Web Consortium (W3C) emphasises *access* rather than *ownership* ("W3C Mission", 2012).

Association: Association means that users should be able to *strongly associate and identify with* the digital material based on their experiences at personal, community and national level. The users should be able to sense that the material has been tailored for them and, preferably, they should even be able to interact with and contribute towards the material with personal stories, ideas and/or viewpoints. With *associated material* the information carries meaning to the learner.

Trust: Trust relates to the willingness to take risks in the belief or hope that another person will not break the trust. Generally people are willing to trust one another, although slight cultural

variances may occur (Hofstede, 1980). Trust has three main interdependent key components namely ability, benevolence and integrity (Mayer et al., 1995). *Ability* refers to the assumption that the other person is capable to deliver in the area wherein he/she is being trusted. *Benevolence* refers to the belief that the other person wants to do good and is not only looking out for his/her personal benefit. *Integrity* refers to the perception that the other person adheres to a set of principles or values that is found acceptable and thus engenders trust.

2 Literature review

The starting point of this research is an attempt to bring about change and nurture development for the world's neediest people. We thus commence with looking at those key factors which need to be considered for fostering development in less developed countries.

From our investigation it has become clear that the key factors to be considered are *education*, *health*, *ICTs* and *infrastructure* as these all play crucial roles in facilitating development on an individual as well as a national level.

Our focus, which is emphasising HIV and AIDS education, is thus in line with that which will make a real difference in peoples' lives. Our main tool to affect this change is technology (ICTs) and this means that we need to look at the infrastructure of ICTs as well.

With that having been said, we need to investigate the educational systems and the learning which takes place, at different levels, in those contexts we choose to work within. We need to ask ourselves the important question: What kind of learning is taking place and what are the obvious short comings?

Recurring challenges for learning include a shortage of resources (books, qualified teachers, etc); a lack of basic school services (toilets, Library, canteen, clean water and electricity); big classes and teaching which emphasises memorisation rather than deeper understanding (UNESCO, 2012) and (Valerie, 2005).

From literature we deduce that *real learning* takes place when information is turned into knowledge, comprehension,

application, analysis, synthesis and evaluation (Bloom et al., 1956). For this to happen, we need to go back to our own childhood to rediscover the useful tool of *storytelling* and we need to grasp how it can help us reach deeper levels of learning compared to the mere memorisation of information.

As regards the lack of teaching and learning resources, this can be addressed by firstly, and most importantly, having students involved in the creation of contextualized stories based on the learning materials. These learning materials should, in turn, be able to support deeper levels of learning. We could also introduce new technologies to offer support in instances where there is a lack of human resources.

In our focus on HIV and AIDS education, the use of technology has become an even more useful tool as there is such a strong stigma attached to the disease (Becky et al., 2009). Talking openly and freely about the disease and its causes is difficult. Technology can help in that it can provide a *neutral platform* for learning about HIV and AIDS.

2.1 HIV AND AIDS

Changing people's attitudes towards AIDS has been found to be a significant factor in HIV/AIDS prevention. In a systematic review of studies on the reduction of HIV/AIDS stigma, Brown et al. (2003, p 46-69) reported that: "*stigma and discrimination related to HIV/AIDS undermine public health efforts to combat the epidemic. AIDS stigma negatively affects preventive behaviours (e.g., condom use), HIV-test seeking behaviour, care-seeking behaviour on diagnosis, quality of care provided to HIV-positive patients, and perception and treatment of persons living with HIV/AIDS by communities, families and partners.*" Brown et al. (2003) further found that interventions, combined with skill building and information, were more effective in reducing the HIV/AIDS stigma than information alone. Reviewing this domain we

found that ICT has been used almost exclusively as a means of information dissemination, rather than as a platform for learners to elaborate on prevention information and to express their attitudes about HIV/AIDS.

In a review of culturally grounded HIV/AIDS prevention strategies, Wilson et al. (2003) recommended that culturally-competent prevention interventions should be designed with the following recommendations taken into consideration. *Firstly* interventions should be based on best practices that take an in-depth and multifaceted approach to culture into account. *Secondly* they suggest that a meaningful approach to designing HIV interventions should take into account theories relating to the way in which cultural contexts shape behaviours related to the transmission of HIV. *Thirdly* they recommend taking a broad perspective to the concept of culture. These recommendations point out that *cultural-competence* in the design and implementation of an intervention is a moderator to the intervention's consequent success. The review of studies on ICT-based prevention interventions indicates that previous interventions have neither been culturally contextualised nor have they combined information and skill building.

HIV/AIDS is an immense problem in many African countries and amongst the African youth. Since sexual education is generally not taught in schools, and talking about sex related issues is a significant taboo, a digital learning environment can serve as an important tool in the fight against HIV/AIDS. Teachers can provide students with access to a digital learning environment where they are then able to gain relevant information. This will save both teachers and students from rather embarrassing discussions. Studies, which focused on young people's views regarding sexual and reproductive health issues in Sub-Saharan Africa, show that their preferences as to information sources are mainly determined by their knowledge of and their belief in the *confidentiality* of the source as well as its *entertainment* factor (e.g. dramas, film and television)(Amuyunzu-Nyamongo et al., 2005). It has been

shown that young people are generally informed about STIs (sexually transmitted infections), which include HIV/AIDS, but the quality and depth of their knowledge varies and misconceptions persist. There is still a need to educate young people regarding the ways in which HIV is (and is not) transmitted, the consequences of untreated STIs, attitudes towards people living with HIV and the fact that many people may have HIV without presenting with any physical symptoms (Amuyunzu-Nyamongo et al., 2005; Desai, 2004).

Various HIV and AIDS digital learning environments remain localised at their point of origin and thus they only have a local impact. Bada et al. (2008) stated that most existing HIV and AIDS learning environments are focused on the delivery of information rather than aiding those people infected with HIV and AIDS to contribute and support the learning process of students using the learning environments.

The pandemic spread of HIV and AIDS is also an issue that cannot be ignored. The Tanzanian government, together with various non-governmental and faith-based organisations, has recognised the problem and countless HIV and AIDS prevention programmes, campaigns and projects have taken place. Billions of dollars have been poured into the continent in an effort to tackle this modern day plague (Epstein, 2007). However, the general outcome has been rather modest and Sub-Saharan Africa remains the most seriously affected region with AIDS being the leading cause of death in the region (Sub-Saharan Africa, AIDS epidemic update, 2007). One of the reasons for this failure is that most of the campaigns have been based solely on Western approaches to the problem. It becomes clear that a thorough, genuine understanding of local cultures, thinking, practices, taboos, beliefs, values and social structures was absent in most of the cases. Also, HIV and AIDS have all too often been approached as a medical condition only, when its spread is linked to very complicated social issues and cannot be fully understood without paying close attention to this fact (Epstein, 2007).

Whenever HIV and AIDS are being discussed, issues regarding sexuality need to be addressed as well. However this area is strongly regulated by cultural issues, taboos, feelings of shame, secrets and power relations. One of the taboos in the Tanzanian context is for parents to discuss sex with their children. It is regarded as a shameful topic of which the discussion can even indirectly encourage the youth to start experimenting. Traditionally, issues related to reproductive health were taught by elder relatives when the children reached a certain age. With the breakdown of the extended family unit, traditional and informal education has been pushed aside as a result of urbanisation and modernisation. Teenagers are now often suspended in a *knowledge vacuum* as their parents do not discuss sexual issues with them for it is deemed inappropriate. Young people now turn to scavenging pieces of information – often exaggerated, false and even harmful – from sources such as the Internet, other media and gossip which they cannot assess critically (Mbugua, 2004). HIV and AIDS have created a situation where the health and lives of millions of young people are in danger, but social barriers are hindering education which they should be able to access.

In Tanzania the prevalence of HIV and AIDS is estimated at 5.6% (UNAIDS, 2010) and more than 13% in the region of Iringa where the research with *Sura ya UKIMWI* was conducted (TACAIDS 2008) and (Sub-Saharan Africa, AIDS epidemic update, 2007). HIV and AIDS is a serious problem among the Tanzanian youth. The median age of the country's population is 18.5 years and 42% of the population is less than 15 years old (CIA 2011). Young people are especially vulnerable and 65% of the population is below the age of 25 years. It has been reported that more than half of women and 43% of men engage in sexual relations before the age of 18 while only 24% of women and 29% of men (aged 15–24) use a condom the first time they have sex (TACAIDS 2008). Women aged 15–19 contribute 12% of the total fertility in Tanzania. It is commonly acknowledged that young people become sexually active at an early age and

therefore there is a need for interventions targeted at young teenagers.

Although awareness of HIV and AIDS is high, there is no corresponding behavioural change towards safer sex practices. HIV prevention awareness and its consequent modified behaviour *remains actual* as less than half of young people living in Tanzania can correctly answer five basic questions about HIV and its transmission (UNAIDS, 2010). Since sexual education is not a learning area which is addressed at school level and as there is a strong cultural taboo against talking about sex related issues, a digital platform can serve as an important tool in the fight against HIV.

Stigmatisation is a big problem in Tanzania and one of the main reasons why people do not want to know their HIV status, not to mention revealing that status to others (TACAIDS, 2008).

East African students also have many pressing questions that need to be answered, as shown in a Kenyan study conducted amongst the youth aged 12–18 (Njue et al., 2011). This large scale study in Kenyan schools showed that there are plenty of misconceptions about sex, HIV and AIDS, pregnancy, condoms and sexual abuse (Njue et al., 2011). One of the major problems identified is the *stigmatisation* of people which have been infected with HIV (Holzemer, 2007).

In spite of best efforts to integrate information and communication technology (ICT) with HIV and AIDS education, there remains a lack of learning and counselling tools that can reach out to the students, capture their attention and make them reflect on their own life in a way that enables them to make knowledgeable life choices: remain in the high risk zone or stay safe from getting infected. There needs to be a real-life association with the digital material (Beggan & Brown, 1994) in order to avoid the common design-reality gap (Heeks, 2003).

Several digital learning environments for HIV/AIDS education have been developed in Africa and most of them have been designed to address the needs and requirements of the adult population (Bada & Suhonen, 2011b). *The Learning About Living* online learning platform for Nigerian youth and families provides skills to young people and families to empower them in the fight against HIV/AIDS and gender-based violence (Learning About Living, 2012). Learning About Living uses video, SMSs and news services to support communication amongst young people regarding HIV/AIDS prevention. In order to engage a young target audience, lessons were designed using cartoons, exercises, games and quizzes. Over 10,000 questions and answers were communicated via the platform within the first month of operation. In Uganda, mobile phones have been applied to communicate AIDS prevention and testing information. The project was initiated in February 2008 by Text To Change (TTC), the AIDS information centre and Celtel (Zain) Uganda. This project aims to communicate HIV knowledge to the youth of Uganda who are still largely ignorant about the disease (Apunyu, 2011). Another Ugandan intervention is NetAIDS which is a moodle based environment that consists of videos with real life HIV and AIDS stories, dramas, discussion forums and computer games (Bada & Suhonen, 2011a).

Most of the digital materials that we have come across have been delivery orientated and text based and not very interactive. In addition, there are a few educational games on HIV, developed for the youth (Enah et al., 2012). An example of an interactive game is *Fast Car: Traveling Safely around the World*, which is available in English, French and Russian. In this game the player drives a car in different parts of the world and he/she needs to avoid obstacles on the road. Occasionally the player has to answer HIV related questions correctly and is then rewarded with extra points (UNESCO, 2010). Another game which focuses on the relationship of four teenagers is *What Would You Do? - Ungefanyaje?* It was developed by UNICEF and translated into Swahili (UNICEF, 2006), the link for downloading the game has however been removed from their

web site. Our experience is that these games do not pay any deeper consideration to local contexts, apart from being translated into different languages.

Learning materials are often not based on the realities faced by young people but rather on academic models presented from a different, or even global, perspective. An example of this is the commonly adopted ABC model where A stands for *abstinence* (not engaging in sex or delaying your first sexual encounter), B stands for *being safer* (by being faithful to one's partner or by reducing the number of sexual partners) and C stands for correct and consistent use of *condoms* (UNAIDS, 2004) and (AVERT, 2011). Extensive knowledge and research as to the causes of infection have been narrowed down to a simplified model which is used in campaigns to make young people aware of the risks and to urge them to consider changing their behaviour. Despite success stories from ABC campaigns, the model has a number of inherent shortcomings. Firstly it does not emphasise knowledge of your status or that of your partner. An *unknown status* means that any unprotected sexual intercourse can put someone else at risk. Secondly the model contributes to the stigmatisation of infected individuals as being unfaithful to their partner.

The stories that were collected for the development of *Sura ya UKIMWI*, the story-based educational platform presented in this thesis, were carefully analysed by Eija Riitta Kinnunen in her research on attitudes of the youth towards HIV and AIDS in Tanzania (Kinnunen, 2010). Her findings noted that all the youth's stories represented a *warning approach* to HIV prevention where those young people who practice risky sexual behaviour become infected with HIV and pass away. From the stories she could also deduct that HIV is viewed as a *disease of collective shame* in Tanzania. The youth see HIV infection in a very negative light and this gives rise to various negative reactions which ultimately affect an individual's status and life opportunities negatively. It was also noted that the stories show the impact of the economic situation on young people's daily

lives and their subsequent selection of sexual partners in urban settings. She further highlights the role that the media plays in portraying *success and attractiveness* to young people in terms of *being fashionable* and *owning luxury goods*. These created images pressure young people to acquire expensive luxury products. On the other hand, young people have very limited opportunities to earn extra income in urban settings in Tanzania. Because of this, the relationships of young people often appear to be founded on *economic considerations*. The only recourse available to many young women is to barter sex in exchange for goods, clothes and money. At the same time young men struggle and fail to attract the attention of the most desirable girls unless they can show that they have money and wealth. The stories also indicated that *good luck* is often regarded as the only method of protection in daily sexual contact and therefore young people live in constant fear of HIV. Her analysis of the collected stories can help towards a better understanding of the attitudes that govern the Tanzanian youth.

2.2 TRANSFERABILITY

In paper (II) we evaluated the transferability of *Sura ya UKIMWI* to a Ugandan context. We used the CATI and FODEM models to analyse the design, functionality and implementation process from the perspectives of dumping, planting and seeding (Suhonen et al., 2006; Vesisenaho, 2007). CATI is a model which is used for technology transfer processes (Vesisenaho, 2007). The CATI scheme models *two opposite approaches*, ITAC and CATI. According to the ITAC approach which is followed in many, usually unsuccessful technology transfer processes, the technology is first imported (I), then transferred to its potential user (T) who is supposed to identify an application for it (A) that is meaningful for the people in the context (C). This process usually results in irrelevant technical solutions that people hardly use, and almost never maintain. Importing technology without taking the local context into consideration is equal to bringing a tractor to a place where it is impossible to find spare

parts or diesel. In the CATI approach the context – its resources, strengths and needs – is the starting point for technology design (C). The intended technology design determines the application (A), which again requires certain technology to be transferred for implementation (T). Finally, some of this technology needs to be imported (I). Contextualised technology would be technologies which are developed based on the needs in a certain context, preferably by or in collaboration with the end users. In FODEM (Suhonen et al., 2006) the development process consists of three interacting components namely that of *needs analysis*, *implementation* and *formative evaluation*.

2.3 PARTICIPATORY DESIGN

User-centred design, a standardised development process (ISO 13407, 1999), refers to a set of practices and methods that claim to impart several desired features and characteristics to the target platform. The predominant concern is that the interactive products are usable (Sharp et al., 2007). It is also accepted that in order to create a usable platform, its users need to be at least considered, or at best be directly involved in the design process. It is, however, difficult to design platforms that address the actual needs of the users (Bednarik et el., 2007). This is especially true in a cross-cultural ICT development in which the understanding of the users and their real needs and motivations are only some of the main challenges in the design process. In ICT development projects active involvement of the users in the design of a platform (as advocated by the Participatory Design framework) is often a task on its own rather than a pre-supposition.

In the process of developing the *Sura ya UKIMWI* platform and in the design of the digital stories for the platform, we aimed at promoting students' awareness according to the self-determination theory (Deci et al., 1991) where students learn to value education and gain confidence in their own capacities and attributes. These affordances will help them to consider their

own behaviours and predict the outcomes of those behaviours through reflecting upon their own, as well as other's experiences.

By inviting the students to co-design, we promoted ownership of and positive associations with the created material. This allowed students to personalise the content in an effort to engage and involve them in a creative manner (Ehiyazaryan, 2008). Tanzania, as a country where most students have not been exposed to this kind of approach, provided a research context where it was relatively easy to differentiate between the *barriers to* and *the enrichers* of digital storytelling to promote learning.

The tools and techniques of participatory design promote a practice where designers are able to learn about and from users' work and where users in turn are able design new innovations themselves (Törpel, 2005; Ehn, 1993). A variety of methods are used in participatory design to collect relevant data and to guide the design and development process. These methods include working groups, intensive workshops, visualisations, prototypes, ethnographic field work and participant observations (Muller et al., 1993; Kensing et al., 1998).

We emphasised the gaining of first-hand experiences regarding the participants' behaviour, both individually and as a group (Randolph, 2008). Typically of educational research (Cohen & Morrison, 2000) we were active participants in the workshop. We worked with the children, guiding and helping them and also making observations as to their activities. The observational method keeps the researcher sensitive to the contextual richness of the research situation (Randolph, 2008). The observational method has been argued to be especially important where the *sequences of events*, rather than single events, are of interest (Frechtling et al., 2002). The observational setting in this study was an obtrusive one, as the workshop participants and assisting teachers knew that they were being monitored (Bernard, 1995). However, an unobtrusive approach would have been difficult to arrange in this research context, where the

facilities and infrastructure are lacking, the equipment and material are scarce and the availability of tools and equipment is minimal.

2.4 STORYTELLING

Making use of stories in education is a powerful tool that helps the learner to associate with the learning material and which stimulates the memory of the learner through the use of his/her imagination. Storytelling thus enhances the *imagination* and *creativity*. Storytelling is a traditional method of knowledge transfer that stretches back to beginning of humankind and which has been widely used in Sub-Saharan Africa where older generations have educated the younger generations through the sharing of stories that have often been passed down from one generation to the next.

Storytelling is an ancient human activity (Miller, 2008). In many cultures, people use stories to make sense of their world and to pass knowledge on to future generations. Making use of stories in education usually starts during early childhood when parents teach their children values and understanding of the world using language and metaphors that can easily be understood by the child. Educational stories are typically told by the educators in order to convey certain values or information to the learners. In many African cultures oral traditions are current and promoting the growth of African narratives has been proposed in order to support literacy (Chinweizu & Madubuike, 1983). This study shows how technology can renew the use of storytelling in education (and even more surprisingly) in the African context.

The use of stories in education has been found to be most useful in language learning, dealing with emotionally-laden subjects and for encouraging students to share their personal experiences (Woodhouse, 2008).

Woodhouse (2008) listed *six advantages* of storytelling in education. *Firstly* he argued that students can use storytelling to share stories of success and develop a sense of community. *Secondly*, by using storytelling students can explore their personal roles and make sense of their lives. *Thirdly*, storytelling can enhance creativity and imagination and it can help to focus the minds of students. *Fourthly*, in storytelling the use of imagination enables stories to be remembered. *Fifthly*, storytelling enhances critical thinking and listening skills and *sixthly* storytelling maintains the oral tradition.

Woodhouse (2008) also listed *six disadvantages* of storytelling in education. *Firstly* he argued that storytelling is time-consuming. *Secondly* he states that students require a safe environment and may feel uncomfortable to share their stories. *Thirdly*, topics in storytelling may challenge personal values and therefore be perceived as threatening. *Fourthly* students may need some guidance in the storytelling process to help them get started and stay within the scope of the desired topic. *Fifthly* the students' response may depend on their previous exposure and *sixthly* storytelling requires visualisation skills and may not suit everyone's learning style.

In general storytelling in group context benefits the participants by offering contextual grounding, facilitating bonding among individuals, validating and affirming experiences and educating others (Banks-Wallace, 2007).

Digital storytelling uses digital media to express, store and share stories. The difference between digital storytelling and traditional storytelling is that it, through the use of evolving new technologies, opens up new possibilities to presenting and sharing stories (through the Internet for instance). Digital storytelling allows for more interactivity and facilitates options for non-linear storytelling. Digital stories are generally presented through the combined use of photographs, video,

animation, sound, music, text and narrative voice. The possible channels and ways for presenting digital stories are endless and the potential of digital storytelling has yet not been realized.

Digital storytelling used in education is "well-positioned to take advantage of user-contributed content and to help teachers overcome some of the obstacles to productively using technology in their classrooms" (Robin, 2008).

A digital storytelling study in Egypt showed that as students personalised their experiences, so they were able to think more deeply about the topics (Sadik, 2008). In this study students did not only report on facts but also reflected on their own thoughts and engagement with the subject—both visually and aurally. Students also practiced reflecting and writing about people, places, events and problems that characterised their individual life experiences. The study also showed that digital storytelling provided a unique opportunity for students to acquire new media literacy and ICT skills (Sadik, 2008).

In literature we find reports on the use of one-to-one computing in developing countries (Pal et al., 2009) as used in the dreams workshop which is further explained in paper (IV). In addition there are quite a lot of reports relating to experiences in games and storytelling workshops (Fullerton et al., 2004; Miller, 2008; Bers & Cassell, 1998). However, the combination of a contextualized game and storytelling workshop and one-to-one computing *in Africa* has not been reported upon in research literature. The hypercontextualized game developed during the workshop refers to a locally designed game that supports its players in gathering context-specific information and in-depth understanding and knowledge regarding the context of a site. Due to their contextual specifics, hypercontextualized solutions are not aimed at the mass markets, but at a narrow, specialised market segment (Islas Sedano et al., 2010). One of the main ideas of the workshop was to develop a story based game that was rooted in the specific context where it was going to be

played. The resources available on-site are employed in the workshop's design and development.

Components similar to those of serious games (Sedano, 2012) benefit digital games and storytelling platforms. These components make the learning environments relevant, explorative, emotive, engaging and rich with complex challenges. They should also support authentic learning activities that are designed as narrative social spaces where learners learn through the exploration of multiple representations and reflection. The learning environments need to be gender-inclusive, include non-confrontational outcomes whilst also providing appropriate role models (Amory, 2006). Our analysis indicates that these features are difficult to find in the existing HIV related digital learning environments developed for Southern African young people.

2.5 DESIGN MILIEU

In the terminology of educational technology the concept of an *environment*, such as a learning environment, has assumed a somewhat *artificial connotation* of being built or constructed, hinting at the result of a design process in an isolated laboratory. This has caused the well-known *design-reality gap* (Heeks, 2003) in which, amongst other things, the crafted learning environment conflict with the realities of its users. This design-reality gap is especially prevalent in African and other developing contexts. A natural design milieu should ensure that the created artefacts or frameworks function – thus effect a change – in practice. The main difference between a developing and a developed context is that most design takes place in a developed context whereas technologies are used in both. This results in a design-reality gap in most developing contexts.

The emphasis on *physical place* can be seen in the vast array of developmental projects in Africa. International donors channel millions of dollars into the development of infrastructure which

is then, especially in the area of educational technology, easily reduced to establishing units like Community Multimedia Centers (Vannini et al., 2012). These developments highlight the expectation that Africa can create, not only consume, and that there will be a physical milieu that makes a difference. Our focus is thus not on the learning outcomes reached by the designed tools, but the milieu in which the design itself takes place.

In recent years *Living Labs* have become a popular concept. The idea behind Living Labs is basically to create an innovative milieu where academia, citizens, business and government officials can co-create technological solutions for the people in a real life setting. A *user-centred approach* is applied where the rationale is to identify good ideas, as proposed by ordinary people, and in so doing draw the development hub closer to communities where people work together with researchers and experts. A central idea is also to make the innovation process as open as possible so that outsiders and experts will be able to contribute with solutions (Følstad, 2008). The openness has also encouraged the formation of strong networks between different Living Labs in order to support and learn from each other such as in the case of The European Network of Living Labs (www.openlivinglabs.eu). In the field of ICT for development (ICT4D) Living Labs have attracted attention as they possess the potential to empower rural or disadvantaged communities to be inventors themselves and to consequently make a profit from their good ideas. Government and aid organisations have attempted to start living labs in rural communities in many countries in Southern Africa. Despite great interest from donors and governments, there have been a great many challenges in starting living labs that are, in fact, living and flourishing entities which benefit their community. There are however a number of successful Living Labs in Southern Africa such as Rlabs (Parker et al., 2010), Siyakhula Living Lab (Gumbo et al., 2012) and iHub (Moraa & Gathege, 2013).

Using ICT for change and development is what motivates this study as we believe that ICTs can improve the quality of life of the world's neediest people (Dias & Brown, 2009). However, applications and technology have often been merely *transferred* or *duplicated* from a developed context to a developing context with poor results (Unwin, 2009). For ICTs to benefit developing communities, it is important to ground them in the context. This is best done by involving users in the design of the ICT-based interventions.

One of the key pillars for effecting change and development is *education* where ICTs can enhance the quality of the learning process. Creating relevant solutions for local contexts requires mastery of the available technology, in some cases even programming. Young people should not only be taught to be *users of technology* but should also be given the opportunity to be *creators* themselves (Maloney et al., 2008). In designing learning environments, in particular, we need to cater for the affective, social, cultural, historical, cognitive and philosophical interactions within the context (Thomas, 2010). Cultural practices, traditions, languages, beliefs and livelihoods must all guide the design processes for the creation of successful educational solutions that aim to stimulate development (Dias & Brown, 2009).

Contextually relevant changes for education require *creativity* in the design process for learning environments. Creativity is essential to foster new innovations (Kultima & Paavilainen, 2007) and to create inventions that work in practice: in essence, *applied imagination*. However creativity is often associated with urban and developed, rather than rural or developing contexts. Typically, creative places are considered places where newcomers are quickly accepted and where anyone can fit in, where people can be themselves and not have to adhere to any one identity. Creatively minded people enjoy a mix of influences and they want to socialise with people that think differently than they do. These individuals favour *active participatory recreation* over *passive institutionalised forms of*

thought (Florida, 2002). For towns and cities to progress and flourish it is necessary to foster a creative atmosphere in which innovations and novel ideas can grow and be capitalized upon. A Creative City identifies, nurtures, attracts and sustains talent so that it is able to mobilise ideas, talents and creative organisations (Landry, 2000). Contrary to literature, we are looking at the creativity and potential of creative design milieux in modest and poor, but developing contexts.

This research takes place at the *intersection* of the research fields ICT for Development (ICT4D), learning environments and creative milieux. *Change* is the common denominator to all three fields. *ICT4D* aims to create a better learning environment through technology. *Learning environments* aim at enhancing knowledge, skills or attitudes as learning outcomes. *Creative milieux* would imply a generation of innovative ideas, finally leading to change. Somewhat surprisingly, within the developing contexts, the element of *change* has not been emphasised in any of the before mentioned three fields. Information systems orientated ICT4D research has mostly been *evaluative* in nature which has made it conservative (Walsham, 2012). In digital learning environments the focus has been on cutting costs by transferring the same learning curricula and materials, only through a *new medium* rather than changing and innovating the learning itself (Cronje, 2006). Creative milieux have not been supported and emphasised enough in most African school systems as creativity is difficult to control and it can lead to change which is often considered more of a threat than a desired outcome (Minette, 2012).

Setting-up a digital laboratory in a foreign context is not sufficient. The design process must be determined by the context in which it is taking place (MacCormack & Verganti, 2003). The design milieu, as envisioned by us, should be a place in which the design of ICTs for learning makes a difference. The emphasis should be on *revealing* and *utilising* the local strengths and making use of the available resources rather than focusing on the needs. Often there is a strong focus on addressing the

needs and this does not necessarily enable the strengths and talents to benefit the design, a process necessary for improved results or outcomes. We have been working together with schools and students towards setting up creative design milieux on grass-root level.

3 Research design

This chapter aims to *firstly* give an idea of the contexts in which the research has taken place and *secondly* to explain how the papers relate to the thesis research questions. The last section of the chapter will discuss the overall research methodologies used and will then be followed by an explanation as to the research approaches employed in the five different design milieux which are dealt with in the thesis.

3.1 RESEARCH CONTEXT

The five different research contexts included in the thesis differ greatly, even if four of them originated from research experiences in Tanzania. They range from working with younger learners in primary schools to dealing with adult learners at university level. The objectives of the designed interventions have also been diverse and are illustrated in Table 1. In this section the five different research contexts will be described further.

Table 1: *Overview of the five research contexts included in the thesis*

Design milieu	*Place of design*	*Level*	*Primary learning contents*	*Intervention and its technical platform*	*Design team in addition to the researchers*	*Secondary learning contents*
1. Kidugala Sec. School	Kidugala, Rural southern Tanzania (2002)	Secondary school (after classes)	Java programming	Web materials, Java applets	15 students and one school teacher	HIV and AIDS
2. Tumaini B.Ed.	Iringa, Urban southern Tanzania (2003)	University, B.Ed.	Java programming	Web materials, I-BLOCKs	27 Students, 1 teacher	Robotics
3. TekkiKids	Pretoria, Urban South Africa (2007)	Primary school (after classes)	Creativity in the design process, engineering skills	Framework for starting technology clubs in South Africa	36 students, 5 teachers (one from each school)	Programming
4. SuraYa UKIMWI	Iringa, Urban southern Tanzania (2008–2009)	Primarily secondary school	Design and implementation of digital multimedia	Web materials, CD, book based on stories; Flash	6 schools involved, 70 students in total	HIV and AIDS
5. Dream workshop	Iringa, Urban southern Tanzania (2009)	Primary school	Digital storytelling	Multimedia stories, OLPC XO-1	17 students, one teacher, 3 university students	Life skills

Sura ya UKIMWI, Iringa, Tanzania

Research setting for paper (II), (III), (V) and milieu 4 in paper (VI).

The *Sura ya UKIMWI* development formed part of the EEPD project which was one of Tumaini University, Iringa University College´s outreach projects. It is connected to the Department of Counselling (within the Faculty of Theology) and its overall aims were to *improve* and *support* the counselling programme and its curriculum.

The *Sura ya UKIMWI* development took place in Iringa which is the major town in the Iringa region, located in the Southern highlands of Tanzania. The six secondary schools involved in the project were all situated within the city boundaries. Three of the schools were boarding schools with students attending from different regions in Tanzania while three were day schools with most of the students coming from Iringa. There were significant differences between the schools as far as buildings, resources and teaching aids were concerned. Three of the schools were short on resources, qualified teachers and study materials; two of the schools were quite well resourced, while one of the schools (a private school) was well resourced by Tanzanian standards. Two of the schools did not have any computers or a computer laboratory available to students while three of the schools had computer laboratories which offered basic computer studies tuition to the students. The sixth school had a couple of computers to which the students had very limited access. The majority of the secondary schools in Tanzania, especially those situated in rural areas, do not however have computer labs available to the students (Hare, 2007).

The language used for educational purposes in primary schools in Tanzania is Swahili which, in most cases, is the students' second language. The students' tribal language would be their first language. Tanzania has more than 120 tribes, each with its

own language. At secondary school level the language of instruction is English. This presents the students with a challenge as their first two years in the secondary school can be quite daunting until they are more fluent in English (Brock-Utne, 2007).

Figure 4. *A selection of pictures from the 'Sura ya UKIMWI' project*

In the upper left corner of the Figure 4 montage is a sample of the graphic illustrations made for the *Sura ya UKIMWI* platform. In the upper right corner is a photo depicting a sound recording session by the drama group that assisted in the dramatization of sounds for the platform. The lower left corner shows a testing session during which the platform is being tested in a counselling session by students from Tumaini University at a community centre. The lower right hand corner shows a graphical interface of the digital platform which consists of five digitalized stories supported by links to additional material on topics related to HIV/AIDS including stigma, prevention, treatment, counselling and transmission.

Working for my dreams, Ukombozi Primary School, Tanzania

Research setting for paper (IV) and milieu 5 in paper (VI).

As part of their studies IT (Information Technology) students at Tumaini University in Iringa entered a competitive call for projects by the One Laptop per Child (OLPC) foundation in 2008. One of the students' projects was selected by the OLPC Foundation and 100 XO-1 computers were donated to Ukombozi Primary School to be used for an educational project run by Tumaini's IT students. At present Ukombozi Primary School is well known nationally (from general public to ministerial level) for its one-to-one computing initiative. There are hardly any primary schools in Tanzania with computers readily available for student use, so Ukombozi was indeed a pioneering educational technology research initiative.

Figure 5. *Selected pictures from the Dream Workshop at Ukombozi Primary School*

The picture in the upper left corner of Figure 5 shows the graduation ceremony where students showcased their work to the rest of the school and parents and community members were invited to attend. In the upper right corner students are using their XO laptops to create digital content for one of the challenges posted to them. In the lower left corner the children are using their laptops to record video content for the platform. The photo in the lower right corner shows the school with the headmaster and a few students.

Jali Maisha project, Kidugala Secondary School, Tanzania

Research setting for paper (I) and milieu 1 in paper (VI).
A HIV and AIDS programming course was held at a rural secondary boarding school in Kidugala, Tanzania in 2002. The school hosted 200 students from different districts in Tanzania. During their first two years of secondary school, students attend computer classes in which they are taught basic ICT literacy skills, including word processing and the use of spreadsheets. When the course was first announced, 91 students volunteered to participate. Fifteen students from the secondary school were selected to participate. In addition the computer teacher at the school also joined the course. In total 16 participants (aged 14 to 30 years) participated in the course. There were 5 female and 10 male students as well as 1 male adult.

The lessons were conducted Mondays to Fridays between 5 and 7 pm after ordinary classes for a period of two months in 2002. In total the students had 21 lessons (42 hours) in the computer laboratory within 2 months. In addition the facilitator made himself and the computer laboratory available on Saturdays for practical sessions for those students who were able to attend.

At the time of the study there were two volunteers at the school who were working on HIV/AIDS education. The volunteers also took part in the project and provided the students with information concerning HIV/AIDS.

Figure 6. *A selection of photos from Kidugala Secondary School*

The secondary school had a computer laboratory from as early as 1995, but at the time of the course the computers were starting to become outdated. Special arrangements needed to be made to install an early release of the Java environment on the seven 486 MHz desktop computers running on Windows 3.11. In addition the school had one Pentium computer that had Windows 98 installed.

The upper left corner of Figure 6 shows some of the students who were taking part in the programming course. The upper right corner and the lower left corner show students working in pairs to make Java Applets for the HIV and AIDS educational website they were working on. The picture in the lower right corner shows Kidugala Secondary School.

Contextualized course design, Tumaini University, Iringa Tanzania

Research setting for milieu 2 in paper (VI).

This research was carried out at Tumaini University, Iringa University College that is situated in the southern highlands of Tanzania. The University belongs to the Evangelical Lutheran

Church of Tanzania (ELCT). Iringa town is the capital of Iringa region and the town had a population of 106,371 in 2002 with approximately 350,000 people living in Iringa Municipality (United Republic of Tanzania, 2006). The main source of income is derived from agriculture.

At the time the University College had four faculties: Arts and Social Sciences (including the Department of Education), Business Administration, Law and Theology. The student number was increasing rapidly and in the 2006-2007 academic year there were about two thousand enrolled students. Students attend the university from all over the country and many of them study with the support of scholarships. At this stage the basic IT infrastructure of the university was relatively good compared to other universities in the country.

The university obtained Internet connection in 2002, but the poor bandwidth limited its use. The capacity of the connection was less than one megabyte per second for the whole campus in 2006 (Vesisenaho, 2007).

The college was offering basic computer literacy courses and several IT courses were being offered to the B.Ed. students. One of those courses was Introduction to Programming which was the course we were working on contextualising.

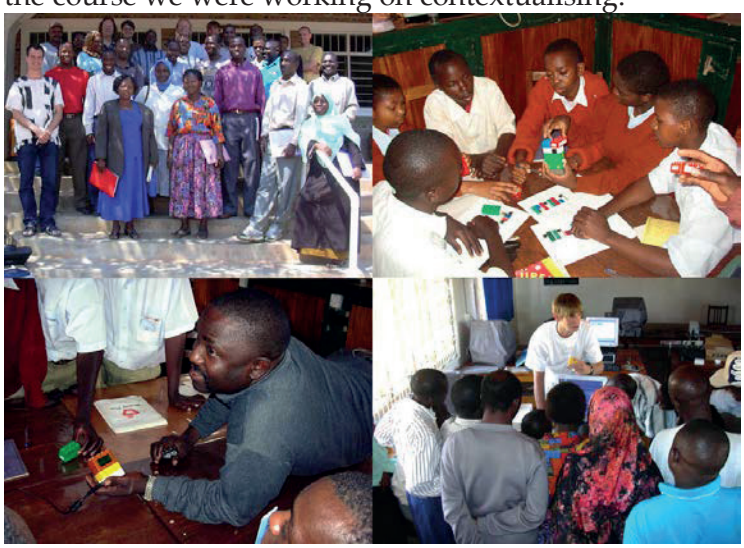

Figure 7. *Selected photos from milieu 2 in paper (V)*

The upper left corner of Figure 7 shows the B.Ed. students who were taking part in the contextualized programming course. The upper right hand and lower left hand images were taken at secondary schools where B.Ed. students were practically teaching programming skills to learners as they would be expected to do as mathematical teachers once they had graduated from University. The picture in the lower right corner shows a demonstration session of programming I-Blocks (Intelligent Lego building blocks).

TekkiKids, Mereka Institute, Pretoria, South Africa

Research setting for milieu 3 in paper (VI).

TekkiKids formed a part of the Young Engineers of South Africa (YESA) initiative carried out by Meraka Institute at the CSIR in Pretoria. TekkiKids was an initiative aimed at widening the pipeline to facilitate the creation of the next generation of scientists, engineers and technologists by awakening and stimulating the necessary learner interest and involvement. TekkiKids was sponsored by the Department of Science and Technology and the Finnish Embassy of South Africa. TekkiKids was based on the Kids' Club model, as developed by the University of Eastern Finland, and was rolled out in close collaboration with the University of Eastern Finland. The intervention took place in Pretoria, South Africa. The project was initiated in the second school term of 2006 and by the fourth term of that same year 36 learners from five schools were involved in two hour sessions held every two weeks. Two under-resourced public primary schools from predominantly black suburbs (Isaac More Primary and FF Ribiero Primary) were paired with a public (Lynnwood Laerskool) and a private school (Christian Brothers College) which were both situated in affluent, predominantly white suburbs and well-resourced. Six learners were selected from each school. The fifth school, Arcadia Primary, a fairly well-resourced public school, was selected on the basis of its learner diversity, both in terms of ethnicity and affluence. A group of 12 learners was selected

from this school. Most of the sessions were held at the Meraka Institute of the CSIR, except for sessions involving the group of 12 learners from the fifth school which were held at the school. The five participating primary schools represented both well-resourced, predominantly white schools, as well as less resourced, predominantly black schools (Marais et al., 2007). For more details see Table 1.

Figure 8. *Selected photos from milieu 3 in paper (V)*

The pictures shown in Figure 8 show either the process of building or already built constructions using Lego Mindstorms made by the children attending TekkiKids.

3.2 RELEVANCE OF PAPERS FOR RESEARCH QUESTIONS AND THESIS

Table 2: *Shows the links between the papers and the research questions*

Question	Summary of question	Related paper
Q1	Added values of digital storytelling	Paper (IV), paper (V)
Q2	Advantages of co-designing with the youth	Paper (III), paper (V), paper (I)

Q3	Factors that facilitate co-design	Paper (IV), paper (III), paper (V)
Q4	Characteristics of productive design milieu	Paper (VI)

The papers included in the thesis thematically support each other and as a combined unit they provide the scope for this research. Papers (III, IV, V and VI) are more thematically matched with the research questions as seen in Table 2. Papers (I and II) do not directly answer the questions but are included as they support both the other papers, as well as the thesis as a whole. In Table 2 the papers are ordered according to their relevance in answering the research questions.

Paper (I) discusses the feasibility of using ICT as a meaningful, culturally-contextualized intervention for exploring and expressing attitudes about HIV/AIDS. It further develops the hypotheses concerning the value added when using ICT education as an *intervention itself* over its function as a mere *disseminator of information*. The research presented in this paper paved the path towards the focus on co-designing with the youth and the development of digital HIV and AIDS educational platforms. The paper also elucidates the *Jali Maisha* milieu included in paper (VI).

Paper (II) deals with the re-contextualization of *Sura ya UKIMWI* for the Ugandan setting. While the direct linkage to the research questions is weak, it still supports the other papers and especially paper (V). As the designed platforms presented in the thesis were designed with a specific context in mind, it raises the issue of what it would take to re-contextualize the platforms for use in other contexts.

Paper (III) explains the design of a digital platform for HIV and AIDS counselling with Tanzanian children. The paper concludes with the benefits of using a participatory design approach as well as basing the design on real life stories. It highlights the advantages of co-designing with young people,

which directly links to Q2. The paper also provides a basis for answering Q3 and gives more background to the *Sura ya UKIMWI* milieu. It therefore also supports paper (VI).

Paper (IV) deals with the advantages and disadvantages of digital storytelling when compared to traditional storytelling. The paper helps to answer Q1 as there is a strong linkage between this paper and the research question. The paper also provides a sound basis for answering Q3 and supports paper (VI) as it gives more background and insight to the design and milieu of the 'working for my dreams' workshop.

Paper (V) provides the answer to the question on how a digital storytelling platform can associate HIV and AIDS material to secondary school students' realities in Tanzania and how contextualized HIV educational material should be designed. Whilst the paper has a strong focus on the development of HIV and AIDS educational material, we also looked at the enrichment factors created by using a participatory design approach where we base the design on real life stories. The paper supports the answer to Q1 and Q2 specifically but it also helps to answer Q3.

Paper (VI) serves as a summary to the whole research and draws together the design experiences included in this research. In this paper we report on the common indicators within design milieux, how these indicators within the design milieu can be measured and how the indicators can be used to improve an already existing design milieu. The paper provides the basis for answering Q4.

3.3 METHODOLOGY

Design Science: Our research design is based on the design science paradigm (Niederman & Salvatore, 2012). The emphasis is thus on *construction* rather than *qualitative* or *quantitative*

evaluation. Our agenda has been to construct learning environments in various developing contexts which we call *design milieux*. The purpose of constructing these learning environments has been to affect a positive change among their users. Thus they have been designed in close collaboration with those young people that make up the target group, the process following a *participatory* or *user-centred* design approach which naturally requires analysis, qualitative, quantitative or mixed methods (Schuler & Namioka, 1993). We follow the *participatory design* approach but from a *design science* viewpoint.

Design science emphasises a *process* that starts with *identifying* a design challenge, then *developing* a solution to this challenge and finally *reflecting* upon the design process in an effort to *validate* the constructed digital artefact. As our target user group for the digital artefact was young people, our intervention drew ideas from the ICT4D research (Unwin, 2009) which emphasises the role of ICT as a change maker (Walsham, 2012). This constructive agenda was another reason for using the design science approach (Sutinen & Tedre, 2010). In design science, the emphasis should be on relevance, credibility and transferability, all the while keeping the re-contextualisation of the design in mind.

The use of the design science approach has enabled us to design change making learning environments and meaningful models for analysing the design milieu, learning environments and the student artefacts.

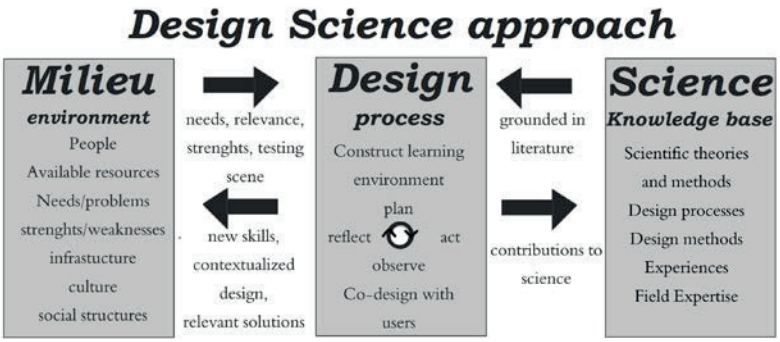

Figure 9. *The connection between the milieu, design process and the science knowledge base in design science*

Alan Hevner (2007) views design science research as a three cycled approach. The first cycle is the *Relevance Cycle* where the environment or context feeds input into the research and design in order to make it contextualised. The interaction with the environment also sets the scene for field testing. The second cycle is the *Design Cycle* within which the construction and evaluation of the designed artefacts and processes involved fall. Hevner refers to the third cycle as the *Rigor Cycle* which uses the existing knowledge base as starting point on which to base the grounding, methods and theories of the research. The research feeds back into the knowledge base with new experiences, expertise, knowledge and findings which then add to the expanding knowledge base.

With Hevner's three cycled view in mind, Figure 9 schematically shows the dependencies between the milieu, design process and the science knowledge base and how design science research was applied in the thesis. The *milieu* feeds into the *design process* with its needs, relevance and strengths and it also supplies a scene for testing the design. In return the design and its process should afford new skills to the milieu, providing a contextualised design and meaningful solutions to the needs within the milieu. From the *existing knowledge base* we acquire scientific methods, expertise and experiences gained from other people's research. While learning from others, design science

research also aims at expanding the existing knowledge base with new design approaches, methods, models and experiences.

Elements of Action research have been applied where *action* has been the motivation. Rather than just analysing the existing situation, the researcher plays an active role in interacting with members within the research setting in order to facilitate viable solutions to problems. Through cyclic iterations of planning, acting, observing and reflecting the aim is to find new working solutions to the problems. Action research seeks to bring together *action* and *reflection*, *theory* and *practice.* In participation with others, its goal is to find *practical solutions* to issues of pressing concern to people, and more generally to facilitate the flourishing of individual persons and their communities (Brydon-Miller et al., 2003). The action research methodology allows for flexibility which is often needed in the African context where conditional factors tend to change at any point in the process. Often one needs to be flexible, adjust to the new conditions and, through trial and error, find what works and what does not. In Action research one needs to be able to handle a certain degree of chaos, uncertainty and messiness. You have to be willing to be wrong and to trust that other people know their own lives and their own interests better than you do. The researcher needs to respect people for the knowledge and experience they bring to the research process. One needs to believe in the ability of *achieving positive social changes through participatory and collaborative work*. In addition there needs to be a commitment towards action (Brydon-Miller et al., 2003).

Yin (1984) suggests that when the boundaries between context and the phenomenon being studied are not clearly evident, the use of a *case study research method* will support one in gaining an understanding regarding the complexity of the study as it helps one to examine contemporary real life situations. Due to the exploratory nature of our research, our research strategy in the dreams workshop, which is discussed in paper (VI), was based on the case study method (Yin, 1984). We followed a qualitative

data collection approach mainly through observations (field work diaries) and log files (video, text and pictures made by pupils) (e.g., Burrell & Morgan, 1979).

***Sura ya UKIMWI* project**

A total of eight months was allocated to the development and design of the *Sura ya UKIMWI* platform, six months during 2008 for the development of a pilot version and two additional months during 2009 for the completion of the final version.

During interviews held with students at the schools it was revealed that all the students had been affected by HIV, whether through personal experience, friends, relatives or people in their close surroundings. In total 37 real life stories were collected from the students. Five digital stories, which were based on the collected stories, were then designed in conjunction with Tanzanian youth. Multimedia clubs were started at two schools to facilitate the development of digital content. Apart from that local talent (in the form of a drama group working with HIV and AIDS information) was brought in to help with the development of the platform. Secondary school students and young people who had just graduated from school produced the graphics, animations and sounds in order to bring the stories to life.

Counselling students from Tumaini University in Iringa helped in the testing of the learning environment and the development of supplementary materials on the areas of prevention, stigma, transmission, treatment, sexual abuse, counselling, relationships and statistics. The additional material was mostly text based and was added to support the stories with facts about the disease and to provide counselling advice to the users. The design approach is explained in more detail in paper (IV).

The platform was designed with Macromedia Flash (now changed to Adobe Flash) which is a powerful tool for developing web based animations. To ensure that as many

people as possible could access the learning environment, it was developed both as a stand-alone application distributed on CDs and as a web based learning environment. In addition a booklet was produced and later part of the material was also made available for Android mobile phones.

Working for my dreams workshop

There were 17 participants who attended the *Working for my dreams* workshops. All the participants were pupils at Ukombozi Primary School and were aged between 11 and 15 years. There were two researchers who facilitated the workshop with the assistance of three university students from the nearby Tumaini University. One of the school teachers and the school headmaster also helped.

The idea of the workshop was to design and develop a story-telling game related to the dreams of the participating children. During the workshop the children were taught to develop digital materials such as texts, drawings, videos and music that would be used in the game. The starting point was the individual dreams of the children and then they were given hypothetical challenges which they might encounter in life which could stand in the way of reaching their goals and dreams. The students had to present their solutions to the challenges given to them. The idea was to use the existing XO laptops at the school as a tool through which the students could express their dreams, goals and ideas for the global community. The material would be made available on the Internet. In expressing their dreams they needed to think about what they wanted to achieve in life and, through the given challenges, they had to reflect upon important choices in life.

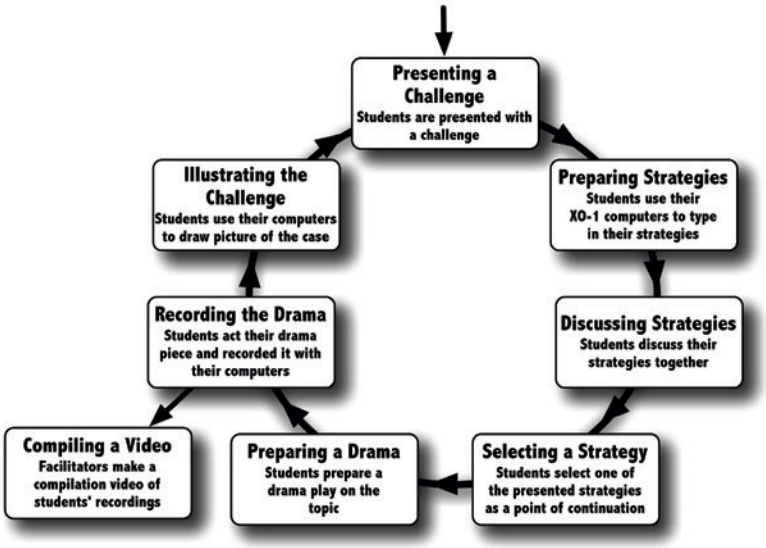

Figure 10: *The cyclical approach followed during the workshop*

The challenges posed to the students were based on their own ideas of what constitutes a threat to attaining their goals. These challenges were formulated in such a way that the students needed to reflect upon issues such as the importance of education and the learning environment, the role of friendship, how to treat people with HIV and the choice of a life partner. The two week workshop ended with a graduation ceremony where the students showed their designed platform to the rest of the school as well as invited parents. The material developed by the students was also made available on the Internet. Figure 10 shows the cyclical design approach which was adopted within the workshop where the students were first given a challenge. Each individual used his/her computer to type approaches towards the challenges. Then, in groups, they discussed and selected a strategy for their group and prepared a drama depicting their strategy to overcome the challenge which they had also recorded with their laptops. In the last stage of the cycle they illustrated the challenge by drawing pictures. They would then be given another challenge and the cycle would resume again. The facilitators collected the digital artefacts made by the students and compiled them into two

different platforms, one which was story based and one that was designed as a game.

Jali Maisha project

A programming course was given to students at the rural secondary school in Kidugala, Tanzania. The course was divided into two phases. During the first phase of the course students were taught the basics of the Java programming language and in the second phase they used their newly acquired skills to develop an educational website on HIV and AIDS. The students named this part of the course *Jali Maisha* which means 'care for your life' in Swahili.

The first month's focus was on teaching and learning programming skills. A standard method of computer science instruction was used, especially in the beginning of the course; the teacher helped the students to learn programming through explanation, by giving examples and by handing out problems and questions.

During the second part of the course (the last month) the students were tasked to develop an informative homepage about HIV/AIDS for the people in Tanzania. They were free to produce material in pairs and small groups, either in their educational language (English) or in the language which they mostly speak (Swahili). To motivate the students, it was promised that the material would also be published on the Internet.

Contextualised programming course

The design took place during three months in 2003 with the target being the development of a contextualised Java programming course together with Tumaini University. Improvements were made in the following year when the same

course was taught to B.Ed. students at the University. The learning materials consisted of educational robotics referred to as I-Blocks (Lund & Vesisenaho, 2004), the Jeliot programming visualisation tool (Moreno et al., 2004) and tailor-made web-based learning materials (Vesisenaho et al., 2006).

Tekki Kids

During a period of one year (2007) a framework for technology clubs for South African primary school children was designed. The children were to learn engineering skills as well as robotics and programming. The methodology was aimed at *learning by doing* where hands-on activities were assigned to the students and where there was an emphasis on experiential learning influenced by the work of Seymour Papert (1992) regarding constructionism. Different equipment was used to stimulate and encourage creativity including Lego Mindstorms which the students used to design, build and program different robots. Technical tutors were available to provide assistance, but the focus was rather on *asking questions* than *providing answers*. The aim was to facilitate a shift from being *passive consumers of technology* to being *designers and developers of technology*. The technology clubs were designed to accommodate schools independently of their resources (Marais et al., 2008).

4 Findings

In the following sections I will present a summary of the results from the papers included in the thesis:

(I) A model (as shown in Figure 11) was developed for analysing the digital artefacts compiled by the students. In order to analyse the level of unique contribution of each student to the website, we used the Multilayered Framework of Compiling Digital Artefacts by Extension (m-CADE) that has three components:
a) *Tools*: The set of applied tools tells which software tools have been used in compiling the artefact, like the Paint programme or a particular programming language. It also describes the level of their usage.
b) *Process*: The level of own contribution in the compilation process as regards initiative, creativity, information, generalization and modifications.
c) *Product*: Quality of the final artefact. A group of Tanzanian secondary school students learned basic programming skills in order to create a web site where they presented their own views on the HIV/AIDS epidemic.

For analysing the development of the students' cognitive skills we combined the m-CADE framework with elements of Bloom's taxonomy (Bloom et al., 1956) as seen in Table 3. Originally the taxonomy had 6 different levels: knowledge, comprehension, application, analysis, synthesis and evaluation. With Bloom's taxonomy in mind we considered knowledge and comprehension as level one, application and analysis as level two and synthesis and evaluation as level three. For easier grouping we reinterpreted the taxonomy to instead consist of the three levels remember/understand, apply/analyse and evaluate/create.

Table 3: *Shows how the m-CADE was combined with Bloom's taxonomy for the evaluation of artefacts*

	Tools	**Process**		**Product**
Level 1 Knowledge (remember) comprehension (Understand)	Word processing or basic use of painting application.	*Drawing/Progr.* Copying or ability to modify existing drawings or programming code.	*HIV/AIDS* Replicating, Summarize or explain HIV/AIDS material.	Message not clear or even incorrect. Presentation/graphics impersonal and/or poorly designed
Level 2 Application (Apply) analysis (Analyze)	Use of few programming methods to make simple animations or advanced technical skills in making digital drawings.	*Drawing/Progr.* Analyze and combine methods and apply it in a different way.	*HIV/AIDS* Compare and question material and apply knowledge into own context	Message is clear and the presentation is quite well designed but not very unique.
Level 3 Synthesis (Create) evaluation (Evaluate)	More advanced programming where user is combining tools and methods in order to make advanced animations.	*Drawing/Progr.* Innovative ways of using skills and tools to design or construct material in new ways.	*HIV/AIDS* Critical evaluation of the situation and express ideas in an innovative way	Well designed and unique personal presentation where message is thoughtful and clear.

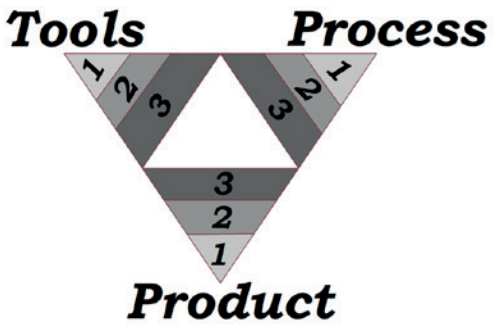

Figure 11. *Graphical representation of the levels as regards tools, process and product for the analysed artefacts*

The content analysis of the web site indicated that the technology had allowed the students to express their knowledge, beliefs and attitudes concerning the disease. The problem with using ICT for not only *delivering* but primarily *processing* information is related to two culturally sensitive challenges: the appropriate use of technology and the role of the learners. During our investigation the students were encouraged to play an active role in the learning process and use the technology as a tool towards self-expression. This approach resulted in a website which was deemed culturally inappropriate, at least in the school's context. At the same time, the website was culturally relevant because the students could elaborate on a problem that was meaningful to each one of them. The results

indicate that ICT offers a challenging platform for health education, also in the context of developing countries. Even the learning of programming skills is not viewed as an obstacle if students are personally motivated to complete a task through the application of their technical skills.

(II) The transferability of the *Sura ya UKIMWI* learning environment beyond its context of origin is analysed using three perspectives: a dumped, sustainable (planted) and viable (seeded) technology. To evaluate the transferability of *Sura ya UKIMWI* in a Ugandan context, we used the CATI model (Vesisenaho, 2007) combined with the FODEM model (Suhonen, 2006) to analyse the design and implementation process and the functionality from the perspectives of dumping, planting and seeding. The paradox of the CATI model is that, although it helps to design technologies relevant to a given context, the contextual technologies might be difficult to transfer to another context, as seen in Table 4. To solve the paradox of the CATI-based design process, we enhanced each of the stages – C, A, T, and I – by an iterative improvement process, based on the FODEM method. In FODEM, the development process consists of *needs analysis*, *implementation* and *formative evaluation*.

Table 4: *CATI Model in the Transformation of Sura ya UKIMWI*

	Dumping	**Planting**	**Seeding**
	Sura ya UKIMWI platform to be used in Uganda as it is	Using the Sura ya UKIMWI platform but with modifications to better meet the needs and requirements for use in Uganda	Design a Ugandan version of Sura ya UKIMWI entirely designed to meet the Ugandan needs.
Contextualize	The level of contextualization is low, since the environment has not been changed	The contextual factors can be taken into consideration at some level; language need to be changed, stories and visual representation need to represent the context.	Requires a development of suitable and appropriate platform built upon the local needs in close collaboration with the end users.
Apply	Some application areas for the original version can be found, since Swahili has been introduced in some of the schools. The predominant language in Uganda is English which is only partly used in the platform.	Use the same platform but make use of local stories, information and language. Students and teachers need to be involved in the story creation process.	Ugandan schools and aid workers might be able to find new ways to apply the original platform. Also open source solutions should be used when adapting the environment in Uganda.
Transfer	General best practices and lessons learned of the platform can be transferred to Uganda	With an English version it might be possible to transfer the material as long as context is somehow similar so stories and visual representation and information still makes sense.	Elements from the Tanzanian Sura ya UKIMWI can be transferred only if it is found to be appropriate.
Import	Even if the context is similar the use of Swahili in the material would make it pretty useless.	Directly imported platform would not be sustainable solution in longer run.	Any imported feature requires careful evaluation with local experts. Importing can only be seeding if no relevant differences in context is found.

The *Sura ya UKIMWI* platform is contextually relevant to Tanzanian young people. We analysed the viability of the platform to the Ugandan context. The main findings were:

1. It would be very difficult to dump *Sura ya UKIMWI* into the Ugandan context, or any other context, since it was implemented in Swahili. Some of the stories and visual representation might also not be appropriate or useful to the youth in Uganda.
2. *Sura ya UKIMWI* could be planted into the Ugandan context, if the language issue could be resolved. Furthermore, the relevance of the stories would need to be tested and teachers and students would need to become involved in the re-development and evaluation.
3. If we wanted to seed *Sura ya UKIMWI* to the Ugandan context, the whole environment would need to be redesigned. Elements of the existing platform could be re-used only where they were found to be appropriate and considered the best possible choice. Another option would be to have a separate design team working on the Ugandan version of the platform.

The results indicate that when a learning environment has been developed following a contextualised approach, it is

not a straightforward process to apply the environment to another context.

The CATI model provides sustainable results in a given context. Combining the CATI model (evaluation oriented) with the FODEM model (development oriented), provides us with a better option for developing generic contextualised learning environments. To make it easier to transfer the platform to a different context, it would be useful to include a feature where end-users can also share their personal stories through the uploading of text, images and sounds. It would also make sense to make use of open source solutions to make the platform more viable.

(III) The key finding of the *Sura ya Ukimwi* project was that the participatory design (PD) process is more important than the production of the material itself. We faced several unexpected events and situations that changed the planned course of action. While these are not entirely novel findings, we believe that our experiences with adopting user-centred design approaches with children in a developing context are valuable and perhaps rather rudimentary when compared to designing interactive systems in the developed Western world.

This study shows how the PD approach is suitable for the development of educational material however it also indicates that sensitivity to the context and change is of particular importance. Our experience shows that the design team needs to be observant regarding unexpected events throughout the process and in turn they need to utilise these in a constructive and innovative way. We achieved this by carefully listening to various stakeholders involved in the process. For example, the importance of *interactive story branching* was adopted and this resulted in not only an entertaining extra feature to the stories, but it also turned out to be an inherent element emphasising the essential decision making stages of an individual required for – ultimately – one's survival.

To achieve behavioural change amongst the youth, the learning environment requires the students to identify with the material in order to reflect on how they and the society around them are affected by HIV and AIDS. Therefore the use of true real life stories by Tanzanian secondary school students for this platform gives the material credibility and provides the target group with a sense of ownership. The material was not generated in a foreign context and so the students can identify with it whilst recognising their own environment in the stories, the graphics and the voices. The participatory process used in the creation of the platform then further increases the ownership, strengthens the user experience and, hopefully, effects the desired behavioural change.

Since Internet, and even computers, are not yet freely available in most Tanzanian schools, alternative means of delivery need to be considered.

(IV) Analysis of the challenges in the *Working for my dreams* workshop was carried out to identify how digital technology enhances storytelling and how it neutralises the disadvantages of traditional storytelling. See summaries of the advantages and disadvantages of traditional storytelling when compared to digital storytelling in Table 5 and 6.

Table 5: *Traditional Storytelling and Digital Storytelling: Pedagogical Advantages*

Traditional Storytelling (Woodhouse, 2008)	**Digital Storytelling**
Share stories of success and develop a sense of community.	Extended community. Extended reach of stories.
Explore personal roles and make sense of their lives.	Similar to traditional storytelling.
Storytelling enhances creativity, imagination and focuses the mind.	Increased facilitation of creative processes and focus.
The use of imagination enables stories to be remembered.	Extended memory.
Enhances critical thinking and listening skills.	Similar to traditional storytelling.
Maintains the oral tradition.	Provides a virtual platform for oral tradition.
	Increased motivation, woven stories (Nuutinen et al., 2010).

Table 6: *Traditional Storytelling and Digital Storytelling: Disadvantages*

Traditional Storytelling (Woodhouse, 2008)	**Digital Storytelling**
Time in preparation.	Initially more time spent to learn new digital tools. Recording and editing add time. Can save time in re-use of material and presentation.
Students require a safe environment and may feel uncomfortable to share their stories.	Neutral platform.
Topics may challenge personal values and therefore be experienced as threatening.	Impersonal conduit for sensitive topics.
Students may need direction and guidance at various stages of storytelling.	New digital tools require additional guidance.
The response may depend on previous exposure.	Similar to traditional storytelling.
Requires visualisation skills and may not suit everyone's learning style.	Offers more variety for different talents in visualisation.

Digital storytelling offers a number of advantages compared to traditional storytelling. It provides a neutral platform where students feel safe to share their stories, even if dealing with sensitive topics. It offers a variety of ways for people with different talents to express their stories according to their own liking. It increases the motivation for the storytellers. It provides an extended reach for the stories, even outside the community where the listener or viewer can learn from the stories. It further enhances creativity, imagination and concentration. It maintains the oral traditions that can be stored for the next generation.

Table 6 shows that, while the disadvantages of digital storytelling is similar to traditional storytelling, some significant differences do exist. Digital storytelling is a timely process especially if the students are not conversant with IT tools and applications. The advantage however is, the possibility of reusing some of the digital components thereby reducing the preparation time. Secondly, students require a safe environment to express themselves as they may feel uncomfortable sharing their stories for fear of judgement. Here, computers provide a neutral platform where they can more easily share their thoughts with a machine rather than a human, as the machine won't judge or

ridicule them. Thirdly, topics in storytelling may challenge personal values and can therefore be threatening. This can be an advantage if the purpose is to challenge the personal values in order to reduce stigmatization for example. However, digital stories are less threatening than traditional storytelling, as the computer offers an impersonalizing conduit for sensitive topics, and is therefore less intimidating than face-to-face sharing of thoughts. Fourthly, students may need guidance in storytelling. In digital storytelling students generally need additional directions as using digital media for storytelling is mostly a new concept for them. Fifthly, similarly to traditional storytelling, the students' responses depend on their previous experiences and exposure. Sixthly, storytelling requires visualization skills and may not suit everyone's learning style. Digital storytelling, however, allows the storyteller to visualize stories in various ways, giving more space for different skills. Hence, students are more likely to find a visualization method suitable for him or her.

(V) We identified a sequence of four barriers that narrow students' awareness of HIV and AIDS in conventional delivery-oriented e-learning material. The identified barriers are *theoretical* barrier, *cultural* barrier, *pedagogical* barrier and *technical* barrier. These barriers filter out the richness of the existing reality which the students experience and in turn represent in their own real-life stories. The end results are learning environments that the students experience as boring and alien, because the vividness of their real life experiences has been smoothed over. This means that the students cannot relate the learning environment to their context as it lacks relevance within the context.

From our iterative design process for the *Sura ya UKIMWI* learning environment, we discovered pillars that associate the targeted end-users' context with the experts' content knowledge. These pillars were identified in the design

process where the students compiled real-life stories into digital form using an easy-to-use web-based platform. Theses pillars (as shown in Figure 12) are relevance, identification, language, entertainment, interaction, answering questions generated from the materials, captivating the students and the importance of user friendliness.

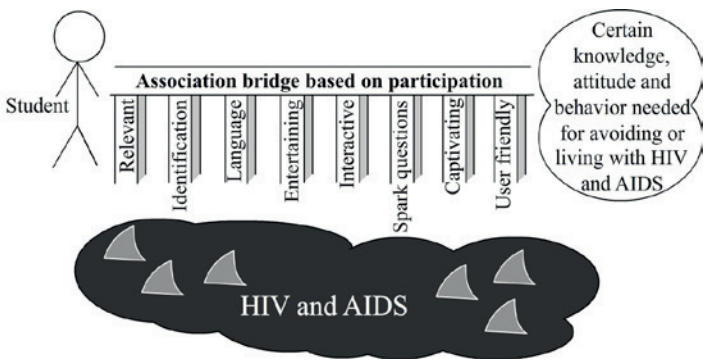

Figure 12. The discovered pillars required for association

By observing the users of the learning environment and its designers, we identified three factors for designing a learning environment that helps students to enrich, not diminish, their awareness of HIV and AIDS. Unlike the conventional approach to delivering learning material on HIV and AIDS, our approach was grounded in the student-designers' immediate reality. Rather than delivery, we focused on design and started from *empirical observations* rather than from *theory*. The first enrichment factor is *cultural relevance*. The second factor, *ownership*, emerged as we based our approach on the students representing their own material in the digital form. The third factor emphasises that learning material needs to be based on *stories*. We showed how these enrichment factors releases the learning environment from the barriers typical to delivery-oriented learning environments.

Based on our experiences, we provided technical and design guidelines for creating digital learning environments for

HIV and AIDS education in a developing context such as Tanzania.

The design dimension ranges from traditional designs by individual professionals to co-designed personalised materials. The delivery dimension starts with the delivery of static materials and ends with fully dynamic materials. Most existing learning materials for HIV and AIDS education are relatively modest in terms of both the design and the delivery dimension.

Sura ya UKIMWI was designed by a heterogeneous group and features medium-level delivery mechanisms. Technically, there is still a long way to go towards learning environments allowing automatic re-contextualisation, the reconfiguration into a new context – its culture, stories and identity. During an eight day workshop with youth from a less advantaged part of Maputo, Mozambique, we managed to do a re-contextualization exercise of the learning environment and we developed one new story in Portuguese during that time. The workshop proved that the design process can be optimised and replicated in a different context with a significantly reduced development time.

Our study was based on a design science approach and the results were influenced by the characteristics of a particular setting and cannot, necessarily, be generalised. However, the end result, the platform itself, can easily be adapted to other contexts, as the example from Mozambique illustrates. Although the design approach has been developed for a particular given setting, it was shown to solve many inherent barriers to any delivery-oriented learning environment. This increases the general relevance of our results. The dependence of a given setting emphasises the validity of our results.

Our design science based study showed how a digital storytelling platform can associate HIV and AIDS material to secondary school students in Tanzania.

In our development research, we created a platform where Tanzanian student designers compiled their real-life stories into a digital form. The design process revealed three enrichment factors which together answered our second question. Contextual HIV educational material has to be culturally relevant, based on students' own work and reality to engender a feeling of ownership among their peers and story based to allow the students to become aware of the dynamics of HIV and AIDS.

Our technical guidelines suggest that emphasis should be placed on *user friendliness* as users might have had limited experiences of digital learning environments. The design should also account for context specific infra-structure limitations such as non-existing Internet connections, low bandwidth or lack of computers. Therefore we found a need to develop different versions of our learning environment in book format, CD format and for mobile devices to complement the web-based learning material.

(VI) Using a set of five diverse design milieux, we have introduced a scoring system (as shown in Table 7) that identifies and analyses the common aspects, characteristics and attributes that helped to shape the design and contributed towards the successes and failures of the design projects and interventions in these milieux. What we have derived from this research is a *tool for descriptive analysis of design milieux*. We needed diverse real contexts to enable us to identify common characteristics. One of the key results was that we managed to find indicators that can simultaneously show failure and success as illustrated in Figure 13.

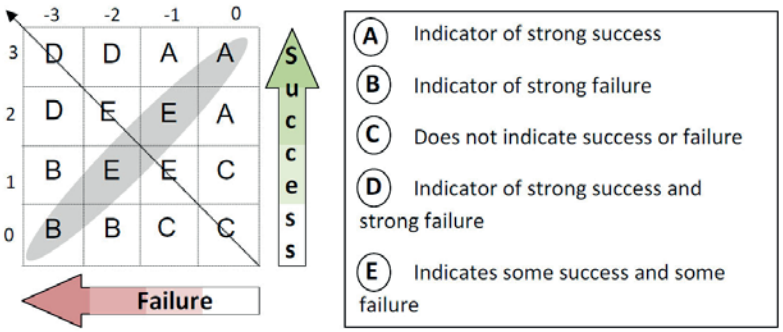

Figure 13. *The scoring options for each indicator*

The resulting scheme can be used for both an analysis of an existing design milieu or to aid in its further development. The analysis can promote a dialogue between the different stakeholders.

In the study, we were more interested in ascertaining indicators for success and failure of the design process and its milieu than the learning environment and its use.
Based on eight years of designing digital learning environments in diverse African milieux, I expect that the research carried out in Africa has relevance to the renewal of the integration of ICT for education elsewhere. The renewal is based on rethinking the very origins of the learning environments, their design milieux.

Table 7: *Scoring code book for scoring of design milieu and intervention*

Success Indicators	*Major success +3*	*Success +2*	*Minor success +1*	*No success 0*	*Major failure –3*	*failure –2*	*Minor failure –1*	*No failure –0*
1. Creative engagement of student designers	Group of students are excited, active, creative, share own ideas and ask questions	There are students that are creative and innovative	Students participate and try but are not creative	None of the students are engaged	Most students drop out and/or show little engagement	Some students drop out, lose interest and take shortcuts	Few students show lack of interest, drop out, lose interest or take shortcuts	No students show lack of interest
2. Support from leadership	Active support and showing great interest	Show interest and are supportive	Shows some interest	Do not display any positive attitudes	Discouraging and work against the success	Condition and complicate the process	Shows some mistrust or skepticism	No negative attitudes encountered
3. Sense of ownership in process and product	Students' represent their own ideas. Students feel in charge and are proud of their results.	Students' ideas are considered in the design process and represented in the material	Students are involved in design process but share only a few of their own ideas in the product	Level of the students' contribution and representation in the product design and process is minimal or non existent	A researcher or an outsider directs the process with no concern to the students' views or ideas	Shortage of originality or students only participate in parts of the design process	Students do mostly what they think is expected or copy ideas	Students are allowed to contribute
4. Freedom of expression	Students open and free to express themselves even with personal issues without feeling judged	Students are able to express themselves freely on occasions during process	Milieu is relatively open but students do not really open up	Students do not express themselves	A very controlled environment where creativity and own expression is discouraged	Strong factors limit students' ability to freely express themselves	Boundaries on certain areas where students cannot express themselves	No limitations in freedom of expression noticed
5. Students developed new expected and unexpected skills	Students actively developed a wide set of expected and unexpected skills	Students learned well according to expectation	Students performed well in some aspects	Students did not learn new skills	Students did not developed new expected and unexpected skills	Students failed to learn some of the key skills needed	Students did not learn some needed skills	No shortage of skills in design process registered
6. Technical equipment and resources	The resources and equipment where enough and contributed to the success	Available resources were somewhat utilized without it limiting design process	Resources were insufficient but design could still take place	Resources were not utilized	Equipment and resources were insufficient and strongly hindered the design process	Shortage of resources affected the design process negatively	Some limitations due to lack of resources	Lack of resources did not affect design process
7. The appearance and usefulness of the intervention	Is useful and unique and people can learn from it and relate to it	Appearance and usefulness of the intervention satisfactory	The intervention was found to be somewhat unique and useful	The intervention provides no value add	Found inappropriate and useless	Not found useful	Partly low quality and not unique	Nothing really negative about the intervention
8. Achievement of goals	Exceeded the pre-set goals and expectations	Reached the goals and expectations	Some goals where satisfactory reached or exceeded	No success in regard to the achievement of goals	Major failures with regards to the goals	Some goals failed	Minor failures in regard to the goals	Goals did not fail
9. Spin-offs	Plenty of positive spin-offs as a result of the intervention	Some important spin-offs as a result of the intervention	Some spin-offs or plans for further activities	No spin-offs recorded	Major negative implications of intervention	Negative implications of intervention	Minor negative consequences of intervention	No negative consequences recorded
10. Openness to outsiders and new ideas	Outsiders are warmly welcomed and their ideas are valued	Outsiders are welcomed and they ideas are considered	Outsiders are conditionally welcome	No sense of openness to outsiders	Hostile towards outsiders and ideas from outside	Some hostile attitudes shown towards outsiders	Skepticism towards outsiders and their ideas	No negative attitudes towards outsiders

5 Discussion

A software design process in a Southern African context compels one to be innovative and to make use of available resources when pre-defined objectives and ideas do not work out according to plan. Unexpected events can occur in any context, but they are especially challenging in a developing country. Numerous unpredictable factors may interfere dramatically with the initial layout of the plan in general, and this can be disconcerting when one enters as an outsider from a very different context in particular. Factors such as cultural aspects, poor infrastructure, corruption and power relations, might delay the project indefinitely and force the designers to employ out-of-the-box thinking to come up with solutions to maintain the process. The transfer of HIV and AIDS educational material from the Western world is often met with suspicion because there is concern regarding hidden agendas and said content is also not generally considered to be relevant to the local context. All of this perpetuates scepticism towards Western world developed material, thereby lowering its credibility even further.

While storytelling has been widely used in the entertainment industry (through television, the game industry, theatre, books and to some extent even music) it has been afforded a marginalised role in our educational systems. I believe storytelling could fulfil a very crucial role in future education, especially as learning becomes progressively more digital in nature. The demand for more captivating and entertaining ways to deliver educational content is growing and making use of educational stories could fulfil a part of that demand.

According to Woodhouse (2008) stories in education have been found to be most useful in language learning, when dealing with emotionally-laden subjects and for encouraging students to

share personal experiences. Woodhouse also lists the disadvantage of storytelling and affirms that it may challenge personal values and therefore be experienced as threatening. I believe that this can be turned into great advantage in situations where we want to change young people's attitudes. As there is a strong stigma attached to HIV, stories can be used to challenge the values and attitudes among young people in order to address these prejudices.

Woodhouse also states that students may need directional input in storytelling. I believe that when designing story based learning environments together with the youth, it is important to *not reinforce* unwanted attitudes through the stories. For instance, in Kinnunen's study (2010) of the stories collected for the *Sura ya UKIMWI* platform she discovered that the youth saw HIV as a negative phenomenon which negatively impacts on individual's status and life opportunities. However good the stories may be, it remains important to direct the storytelling process to *not reinforce negative attitudes* but to tell the stories in such a way that the youth are challenged to reassess their attitudes.

As technology can serve as a neutral platform for discussing otherwise taboo topics, I believe that digital storytelling can play a very important role in educating the youth on sensitive topics where traditionally held beliefs or attitudes need to be challenged. Suggested topics for digital storytelling would be for instance bullying, domestic violence, drug abuse, female circumcision or conflict resolution.

The use of fictional stories might increase the entertainment aspect and may allow for the generating of stories which are not necessarily based on real life and which can, as such, include a wider range of educational components. However, I believe that nothing beats real life and true stories as they increase the credibility of and the ability to feel for the characters in the story. Bringing emotional elements into the learning experience

infuses the process with authenticity and consequently touches a person on a deeper level.

When a learning environment is developed within its own community, or within a similar context, I believe the association with the story and its characters is stronger. This would most likely increase the probability of the learning environment being well received and more frequently used when compared to just another foreign product dumped at the school.

When designing educational platforms for a specific context, one should keep in mind the possibility for re-contextualising the platform as this will make the platform more viable. If the designed platform is *dynamic* and *viable* it should be able to adapt to various contexts and this will be less effort than having to design a new platform from scratch.

Increasing the use of ICTs in education is high on the agenda in Africa. The focus has been, to a large extent, on introducing the technology, being connected to the Internet and (in best case scenarios) training teachers and students. Little effort has been spent on developing content and especially contextualised content. Inviting young people to develop stories based on contextual learning content could be one solution to develop more contextual learning materials.

The use of ICTs in education in Africa is growing and becoming increasingly important. The populations of most Southern African countries are growing and there is a chronic lack of qualified teachers. This situation is becoming worse every year. ICTs are believed to be able to fill part of the gap in the shortage of qualified teachers, especially in rural areas where it is difficult to attract qualified individuals as the salaries offered are generally not competitive.

While most of the efforts in the research have been focused on the co-designing of computer based learning environments, it makes sense to pay more attention to the development of mobile

based learning environments in the future. The performance of modern mobile phones enables endless opportunities for mobile learning. The processes of co-designing mobile platforms with the youth are similar to that which I experienced in my recent work with students at University of Eldoret in Kenya. While a large part of Southern Africa's population remains computer illiterate, many people are becoming *ICT literate* through the use of their mobile devices. They have leapfrogged the use of desktop and laptop computers and are now doing almost everything that one can do with an ordinary computer via their mobile phones. Smart phones are becoming increasingly available and cheaper models have become quite affordable even for less fortunate people in rural areas of Africa.

A crucial aspect of the interventions in the thesis was the emphasis on *participatory design* that was based on the available resources and strengths, rather than the needs, of the contexts.

6 Conclusion

Conclusions reached in relation to the thesis research questions:

(Q1) *Which values are added by making use of digital storytelling in the design of new learning environments for Sub-Saharan Africa?*

Digital storytelling is even more powerful than traditional storytelling as it allows stories to be presented in new ways where visuals and interactivity can add to and enhance the learning experience. Digital storytelling also makes it easier for people to share their story, not only with the direct and present audience in their immediate surroundings, but also with a global audience. Digital stories can also be preserved for future use. A key problem with stories which were narrated in the past, especially true in Africa where stories are seldom written down, is that their continued existence is reliant on society and its structures. Consequently, as societies change and evolve, many of the traditional stories (which in some instances relate the history of the people) have been forgotten and lost. Making use of digital storytelling both ensures and enables the preservation of such stories for future generations.

The use of digital storytelling is also useful for sparking the imagination and creativity of the students. Learning settings in Sub-Saharan Africa are often characterized by traditional learning methods which rely largely on the memorization of information. In these settings creativity is often *discouraged* rather than *encouraged*. Digital storytelling allows students to be creative in both the story generating process as well as the presentation of the story through technology.

In creating the *Sura ya UKIMWI* platform, we also made use of real life stories. This added credibility to the material as it was not only made up of *any stories* but of *real life stories* which were

shared by people who share a similar background and context. However, when working with sensitive topics such as HIV and sexually related issues, one needs to be observant as regards the collection, creation, presentation and dissemination of the stories. In a traditional storytelling environment many of these stories would not have been told as the narrator would not feel free to expose him/herself or the characters in the story. Digital storytelling allows the storyteller to remain anonymous and it also allows the learner to receive the stories from a technical device rather than through face-to-face interaction. In this way the computer, or mobile phone, can function as *a neutral platform* from where the educator *can teach* and the learner *can learn* without risk of embarrassment or judgment.

(Q2) When designing learning environments for the youth in developing contexts, what are the advantages of co-designing these environments together with the young people who live within them?

In designing any learning environment one must look at whom the environment is supposed to be designed for. If the design and content originate in a different milieu than where it is intended to be used *or* if the learning environment is designed by a design team which come from a different generation, there is a significant risk that the users will feel removed from the learning content. A learning environment which is designed without regarding the context of the learners, does not touch the users on any deeper level and this curbs their ability to learn from the designed environment. In the design of *Sura ya UKIMWI* it was crucial to make a novel contribution where previous and existing learning material had failed. We needed to design a learning platform that could help reach out to the youth. By using the *target group as co-designers* and basing the platform on real life stories garnered from the youth within the context, the material became *credible* and *understandable*. By giving Tanzanian young people the opportunity to tell their own stories, we ensured that the stories were told in a language which the students were comfortable with and which they could understand. As the Tanzanian youth also *visualised* their stories

through graphics reflecting their environment, the stories came to life visually in a way which was familiar to the youth because it represented the true environment in which they are living. The co-designers were also able to add *humour* into the material that students actually found amusing.

Since the material was locally produced by the youth there was a strong association with the material. This also helped to instil a sense of *ownership* and *pride* regarding the learning environment in the young people and the schools.

Co-designing learning environments in conjunction with the youth which come from the context help these young people to acquire new skills. The co-designers learn more about the topic dealt with in the learning environment and they also learn about the design process, thus acquiring new ICT skills along the way. They also realise that they can become *pro-active creators* in the digital era and not only *passive receivers*. This realisation enables them to make creative contributions towards the design which, in turn, generates feelings of pride and confidence. They also learn more about team work and they are afforded the opportunity to showcase and share their work, talents or stories with a wider audience.

(Q3) What are the factors that facilitate the process of co-design?

According to the results obtained, the following factors are crucial in order to facilitate co-design with students or the youth in the contexts of this study.

1. It is important that there is good *communication* between the designer and the co-designers where both parties feel that they understand each other and where they feel free to share their ideas.
2. An atmosphere of *trust* needs to be present within the design team.
3. It is important that the co-designers are *committed* and they are continuously *motivated* throughout the process. Preferably, the goals should be the main motivator (intrinsic motivation) but

sometimes additional incentives are needed to keep the motivation high (extrinsic motivation).

4. A clear understanding of the goals and that which is required to reach them should be present. Individuals might have their personal goals as well but it is important that there are *common goals* which the team can work towards.
5. The main motivation for co-designing is the *contextual grounding*. This means that the designer needs to give the co-designers the space to drive their ideas according to their experiences and knowledge of the context.
6. The less experience the designer has of the context, the more important it becomes to involve *local experts* that can help to bridge cultural and language barriers and who can facilitate good communication within the design team.
7. When co-designing with young people and school students, it is important to have a *realistic* and *flexible planning schedule*. The designer should always expect the unexpected and be flexible enough to adjust his/her plans accordingly.

(Q4) What are the characteristics of a productive design milieu?

As identified in paper (VI) there are ten main characteristics to productive design milieux:

1. Students are excited, active, creative, share own ideas and feel free to ask questions.
2. Leaders provide active support and show a great interest in the process and designed outcomes.
3. Students are able to represent their own ideas and they feel in charge of the process and are proud of their results.
4. Students are open and feel free to express themselves, even about personal issues without feeling that they are being judged.
5. Students develop a wide set of expected and unexpected skills in the process.
6. There are enough resources and equipment that can help contribute to the productiveness of the design milieu.
7. The designed intervention is useful and unique and people are able to learn from it and relate to it.

8. The pre-set goals and expectations will be exceeded.
9. There are plenty of positive spin-offs as a result of the intervention.
10. Outsiders are warmly welcomed and their ideas are valued.

In addition to the conclusions in regard to the research questions for the thesis, a tool for artefact analysis, a model for transfer of learning environments into new contexts and a model for analysing design milieux was developed.

In the development of the *code book* which was used for evaluating design milieux, we did not analyse the interdependency amongst the indicators. This is a domain for possible future research. Another field for possible future research would be to use the evaluation tool among the stakeholders in an active design milieu and to then record the discussions and evaluate the ways in which it helps guide the design.

Another area which lends itself to future research is the development of tools to facilitate the easy creation of mobile based digital stories that can be used for generating contextualized learning materials. I would like to see tools that *are not based on video* as it remains important *to limit data usage* for data intensive and video based platforms tend to be costly to use. Students have easier and more frequent access to mobile phones than desktops or laptops and therefore it is important to create tools by which digital stories can be generated directly onto mobile phones.

There is also a need for further research regarding the role of digital storytelling as regards taboo and sensitive topics. Often one of the main objectives in designing HIV and AIDS educational platforms is to achieve a change in attitude regarding high risk behaviours and to address the problem of stigmatisation. More research is needed on how to achieve these objectives in order to effect behavioural changes and whilst we have gained promising indications that digital

storytelling would be useful in this regard, further research is needed.

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Marcus Duveskog

Digital Storytelling for HIV and AIDS Education in Africa

Since 2002 the author has been involved in various projects in which he has been co-designing learning environments with children and youth in different parts of Southern Africa. The research from five different design settings in Tanzania and South Africa has enabled a retrospective analysis in order to identify common characteristics shared by productive design milieux. The thesis will emphasize the possibilities of using digital storytelling to address sensitive and delicate topics such as HIV and AIDS.

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